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Computation, Mathematics, and Logistics Department
Test and Evaluation Report

Proposed Draft Military Specification for General Content, Style, Format, and User-Interaction Requirements for Interactive Electronic Technical Manuals

by

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The IETM concept is described, and an overview is provided of five IETM acquisition Specifications and Military Handbooks developed by the Tri-Service Interactive Electronic Technical Manual Working Group established in 1989 by the Defense Quality and Standardization Office.					
One of these five draft documents, MIL-M-GCSFUI Manuals, Interactive Electronic Technical: General Content, Style, Format, and User-Interaction for, 1 Jun 1990, is described and presented. (Four other companion Reports have been prepared to introduce and describe the four related IETM acquisition Specifications and Handbooks.)					
This report summarizes the types of requirements in the areas of Content, Style, Format, and User-Interaction, which will be common to essentially all types of IETM view Packages, introducing particularly the detailed requirements of MIL-M-GCSFUI with respect to screen formatting and the provision of user functions to assure maximum integration with view Packages as presented on an electronic Delivery Device, in terms of both (1) control of the display and (2) increased effectiveness of use of the whole IETM system. (See reverse side.)					
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Also discussed are those types of general requirements which relate to the type of information presentation used in the View Packages (e.g., procedural information, troubleshooting information). A copy of MIL-M-GSFUI is included in this report as an Appendix.

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A B S T R A C T

The Report summarizes recent activities in the Department of Defense and in the US Navy, Army, and Air Force to establish Service use of Interactive Electronic Technical Manuals (IETMs) as replacements for paper Technical Manuals for logistic support of military equipment.

The IETM concept is described, and an overview is provided of five IETM acquisition Specifications and Military Handbooks developed by the Tri-Service Interactive Electronic Technical Manual Working Group established in 1989 by the Defense Quality and Standardization Office.

One of these five draft documents, MIL-M-GCSFUI, *Manuals, Interactive Electronic Technical: General Content, Style, Format, and User-Interactions for*, 1 Jun 1990, is described and presented. (Four other companion Reports have been prepared to introduce and describe the four related IETM acquisition Specifications and Handbooks.)

This Report summarizes the types of Requirements in the areas of Content, Style, Format, and User-Interaction, which will be common to essentially all types of IETM View Packages, introducing particularly the detailed Requirements of MIL-M-GCSFUI with respect to screen formatting and the provision of user functions to assure maximum integration with the View Package as presented on an Electronic Delivery Device, in terms of both (1) control of the display and (2) increased effectiveness of use of the whole IETM system.

Also discussed are those types of general Requirements which relate to the type of information presentation used in the View Packages (e.g., procedural information, troubleshooting information).

A copy of MIL-M-GCSFUI is included in this Report as an Appendix.

ADMINISTRATIVE INFORMATION

The work presented in this Report was accomplished at the David Taylor Research Center under OMN funding for the Logistics Policy Branch (OP-403), Deputy Chief of Naval Operations (Logistics).

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The effort described in this Report is in considerable part based on the extensive efforts of a number of personnel from the Air Force Human Resources Laboratory and the Air Force Logistics Command (MMDE), Wright-Patterson Air Force Base, Dayton, Ohio, assisted by personnel from RJO, Inc., Dayton, Ohio.

1.0 INTRODUCTION

1.1 BACKGROUND

During the 1980s, it became increasingly apparent that the striking increases in the complexity and sophistication of the weapon systems of all three Services were causing a serious lag in the production, distribution, and management of the Technical Information required to maintain, operate, and support these systems. Of particular concern were increasing weight and space requirements resulting from the increasing bulk of the required paper Technical Manuals.

At the same time, a number of significant technological improvements were being made in the field of information handling, particularly the advent of small, inexpensive, fast computers. Such innovations offered the potential of almost complete replacement of paper-based Technical Information through the use of light, easily stored, highly capable electronically processible media, which at the same time were capable of more effective interactive display to the end user.

Research, Development, Test, and Evaluation efforts of the three Services during this past decade have conclusively demonstrated, both through field tests and through in-house analyses and experimentation, the feasibility and intrinsic value of providing integrated Technical Information in paperless form in such a way that it can be displayed to end users by means of an interactive Electronic Display System.

For example, the Navy Technical Information Presentation System (NTIPS) Program at David Taylor Research Center, the Navy's Lead Laboratory for TI automation, demonstrated under operational conditions the improvements achievable in maintenance-technician performance [Refs (1) and (2)] through the use of electronically displayed TI. Similar results have been achieved by the Air Force under its Computer-based Maintenance Aiding Information System (CMAS) and its Integrated Maintenance Information System (IMIS) programs [Refs (3) and (4)]. The Army has automated Training Information under its Electronic Information Delivery System (EIDS), and has assessed the capability of using field portable maintenance aids under the Militarized Electronic Information Delivery System (MEIDS) program.

In addition, a number of pilot prototype developments and tests involving land, sea, and air vehicles and their weapon systems are being carried out, by individual System Acquisition Managers of all three Services, in an effort to provide interactive and electronically displayed Technical Information.

- Ref (1) Fuller, Joseph J., Theodore J. Post, and Anne S. Mavor, "Test and Evaluation of the Navy Technical Information Presentation System 'NTIPS) F-14A Field Test Results," DTRC-88/036 (Sep 1988).
- Ref (2) Fuller, Joseph J., Raymond L. LeBeau, Anne S. Mavor, Theodore J. Post, and Charles S. Sawyer, "Test and Evaluation of The Navy Technical Information Presentation System (NTIPS), AN/SPA-25D Test Results," DTRC-88/035 (Sep 1988).
- Ref (3) Thomas, D.L. and J.D. Clay, "Computer-Based Maintenance Aids for Technicians: Project Final Report," Air Force Human Resources Laboratory, AFHRL-TR-87-44, August 1988.
- Ref (4) Link, W.R., J.C. Von Holle, and D. Mason, "Integrated Maintenance Information System (IMIS): A Maintenance Information Delivery Concept," Air Force Human Resources Laboratory, AFHPL-TP-87-27 (Nov 1987).

1.2 DOD AND TRI-SERVICE PROGRAMS ESTABLISHED IN RESPONSE TO TECHNICAL INFORMATION AUTOMATION POLICY

To coordinate and standardize the increased use of computer-aided logistic support throughout the three Services, the Department of Defense established the Computer-aided Acquisition and Logistics Support (CALS) program [see Ref (5)], which also has had a wide effect in stimulating progress toward the goal of TI automation, and particularly toward standardization of such efforts.

The Department of Defense established [Ref (5)], and later reiterated [Ref (6)], a policy requiring that access to and the delivery of system-related logistic-support information be automated.

For example, Ref (6) provided the following directions:

- a. For systems now in full-scale development or production, program managers were required to review specific opportunities for cost savings or quality improvements that could result from changing delivery or access using the Computer-aided Acquisition and Logistics Support standards.
- b. For systems entering development after September 1988, acquisition plans, solicitations, and related documents

Ref (5) DEPSECDEF MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS, of 24 Sep 1985. Subj: Computer Aided Logistic Support.

Ref (6) DEPSECDEF MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS AND DIRECTOR, DEFENSE LOGISTICS AGENCY, of 5 Aug 1988. Subj: Computer-Aided Acquisition and Logistic Support.

required specific schedule and cost proposals for:

- (1) integration of Contractor Technical Information systems and processes;
- (2) authorized Government access to Contractor data bases; and
- (3) delivery of Technical Information in digital form.

c. DOD components were to program for automated systems to receive, store, distribute, and use digital weapon-system Technical Information, including achieving the earliest possible date for digital input to DOD engineering data repositories.

More recently, the Joint Uniform Service Technical Information System (JUSTIS) concept has been announced, a planned effort which will combine, to as great a degree as possible, Tri-Service procedures and equipment for acquisition and control of system-support Technical Information.

1.3 THE INTERACTIVE ELECTRONIC TECHNICAL MANUAL CONCEPT

The culmination of this effort throughout the 1980s in response to the DOD policy statements cited has been the development of the Interactive Electronic Technical Manual (IETM) Concept. The IETM Concept involves full application of existing technological capabilities to the problems of providing Technical Information which is both more effective for the end user and more efficient in terms of acquisition, control, and update.

The IETM Concept involves a system approach, which includes basically all of the following components:

- a. A standardized, automated, revisable source Data Base.
- b. Use of a computer-controlled authoring system.
- c. The generation of digital Technical Information (containing text and graphics), either directly by an Author, or automatically by computer. This Technical Information is recorded on an electronically processible medium (optical or magnetic), rather than on paper.
- d. Technical Information (consisting of task-related increments) which is optimally arranged and formatted for interactive screen presentation.
- e. Presentation (display to the end user) by means of a computer-controlled Electronic Display System (EDS) possessing an extensive user-interaction capability. The EDS is capable of displaying the IETM, performing related logistic-support functions, and interfacing with other Service logistic-support Information Systems.

An IETM permits a user to locate required information more easily, and to present it faster, more comprehensibly, more specifically matched to the configuration, and in a form that requires much less storage than paper. Powerful troubleshooting procedures not possible with paper Technical Manuals are possible using the computational capability of the IETM Display Device.

IETMs will be used by maintenance technicians, afloat and ashore; to maintain and operate weapon systems by Intermediate and Depot maintenance activities; and by training personnel.

The IETM Concept has been described in detail in Ref (7).

1.4 PREPARATION OF SPECIFICATIONS AND HANDBOOKS FOR SERVICE-WIDE COORDINATION OF ACQUISITION OF AUTOMATED TECHNICAL INFORMATION

To coordinate this wide-spread effort, the Defense Quality and Standardization Office established in 1989, under the DOD Technical Manual Technology Exchange Subcommittee, chartered by DOD INST 4151.9 [Ref (8)], an Interactive Electronic Technical Manual Working Group, chaired by the Navy, whose primary functions were to:

- a. Foster the exchange of ideas and the agreement on a single approach regarding:
 - (1) the acquisition of IETMs which use computer technology for innovative electronic display; and
 - (2) presentation of Technical Manual Information among all Department of Defense Agencies.

Ref (7) Rainey, Samuel C., Joseph J. Fuller, and Eric L. Jorgensen, "The Electronic Delivery of Automated Technical Information for Logistics Support of Navy Weapons Systems: Potential, System Description, and Status," DTRC-89/007 (Feb 1989).

Ref (8) DOD Instruction 4151.9 of 3 Jan 1989, "DoD Technical Manual Program Management."

b. Develop a set of DOD Specifications for:

- (1) The acquisition of IETM data; and
- (2) The Electronic Display Systems needed for the presentation of IETMs for the maintenance of DOD weapons, systems, and equipment.

The Working Group was also charged with the responsibility of providing a recommendation to the DOD CALS Policy Office concerning inclusion of IETM interchange Specifications into the set of CALS standards; e.g., in connection with MIL-STD-1840.

The Tri-Service Working Group consists of representatives of (a) the David Taylor Research Center (DTRC) of the Navy, (b) the Air Force Logistics Command (AFLC-MMDE), and (c) the US Army Communications-Electronics Command (AMCPM-TMDE).

With DTRC and the Air Force Human Resources Laboratory (as an advisor to AFLC) contributing the primary effort, a series of five Specifications (see Section 2.3) and Handbooks for IETM acquisition has been drafted. This series consists of:

- A Specification governing the nature of the Revisable IETM Data Base;
- A Specification providing general Content, Style, Format, and User-Interaction Requirements for all IETMs;
- A Handbook describing for a System Acquisition Manager the best approach to writing acquisition Specifications

for individual View Packages (to be used for IETM procurement);

- A Handbook presenting requirements for the Electronic Display System;
- A specification presenting requirements for an IETM Quality Assurance Program.

These documents have been widely circulated for comment within both the DOD and Industry.

These drafts were also developed to accomplish as a near-term objective the provision of a suite of IETM prototype acquisition documents for use by major DOD programs in establishing initial IETM capabilities. These programs include the Navy's A-12 Attack Aircraft Program, the Advanced Tactical Fighter Program of the Air Force, and the M-1 Main Battle Tank Program of the Army.

1.5 PURPOSE OF PRESENT REPORT

The purpose of the present Report is to present and to describe in detail one of these draft documents, specifically: **MIL-M-GCSFUI. Manuals, Interactive Electronic Technical: General Content, Style, Format, and User-Interaction Requirements for. 1 June 1990.**

A series of four other Reports has been prepared, each Report describing one member of the set of five acquisition documents prepared by this Working Group [Ref (9) through Ref (12)].

Section 2 of this Report provides an overall description of this suite of Acquisition Specifications and Handbooks. Section 3 summarizes the Approach and Requirements of one of the five documents; in this case, MIL-M-GCSFUI. The draft version of MIL-M-GCSFUI is included in this Report as Appendix A.

- Ref (9) Rainey, Samuel C., Eric L. Jorgensen, and Joseph J. Fuller, "Proposed Draft Military Specification for Revisable Data Base for Support of Interactive Electronic Technical Manuals (IETMs)," DTRC Report 90/027 (Jul 1990).
- Ref (10) Rainey, Samuel C., Eric L. Jorgensen, and Joseph J. Fuller, "Proposed Draft Military Handbook for Preparation of View Packages in Support of Interactive Electronic Technical Manuals," DTRC Report 90/026 (Jul 1990).
- Ref (11) Rainey, Samuel C., Eric L. Jorgensen, and Joseph J. Fuller, "Proposed Draft Military Specification for Quality Assurance (QA) Program Requirements for Interactive Electronic Technical Manuals (IETMs)," DTRC Report 90/024 (Jul 1990).
- Ref (12) Jorgensen, Eric L., Samuel C. Rainey, and Joseph J. Fuller, "Proposed Draft Military Handbook Presenting Requirements for an Electronic Display System (EDS) for Interactive Electronic Technical Manuals (IETMs)," DTRC Report 90/025 (Jul 1990).

2.0 ACQUISITION DOCUMENTATION FOR
INTERACTIVE ELECTRONIC TECHNICAL MANUALS
AND ASSOCIATED TECHNICAL INFORMATION

2.1 DEFINITIONS

2.1.1 The Interactive Electronic Technical Manual (IETM).

As defined by the Working Group, an *IETM* is a Technical Manual, prepared (authored) by a Contractor and delivered to the Government, or prepared by a Government activity, in digital form on a suitable medium, by means of an automated authoring system; designed for electronic-screen display to an end user; and possessing the following three characteristics:

- a. The format and style of the presented information are optimized for screen presentation to assure maximum comprehension; that is, the presentation format is "frame-oriented", not "page-oriented".
- b. The elements of Technical Information constituting the TM are so interrelated that a user's access to the information he requires is facilitated to the greatest extent possible, and is achievable by a variety of paths.
- c. The computer-controlled TM-Display Device can function interactively (as a result of user requests and information input) in providing procedural guidance, navigational directions, and supplemental information; and also in providing assistance in carrying out logistic-support functions supplemental to maintenance.

This terminology is consistent with the standard DOD definition of **Technical Manual**. Ref (8), states:

Technical Manuals are publications that contain instructions for the installation, operation, maintenance, training, and support of weapon systems, weapon-system components, and support equipment. TM information may be presented in any form or characteristic, including but not limited to hard printed copy, audio and visual displays, magnetic tape, discs, and other electronic devices. They normally include operational and maintenance instructions, parts lists or parts breakdowns, and related technical information or procedures exclusive of administrative procedures. Technical Orders (TOs) that meet the criteria of this definition may also be classified as TMs.

2.1.2 The View Package.

IETM information, as provided to the end user for viewing on an Electronic Display Device, will be constructed in individual task-oriented increments called View Packages.

A **View Package (VP)** is a fully organized and formatted item of computer-processible Technical Information derived from an IETM Data Base and capable of interactive electronic display to an end user by means of an Electronic Display System (EDS). In function and design, a View Package is completely equivalent to an individual Interactive Electronic Technical Manual. A View Package may be constructed:

- a. entirely by an Author using an automated authoring system;

- b. completely automatically using a series of automated processes (software) which perform the data-selection, structuring, and formatting processes; or
- c. by a combination of the above two approaches.

A View Package is designed to support a specific function in the operation or logistics-support of a weapon system or other military equipment.

2.1.3 Nature and Purpose of the Revisable IETM Data Base

As noted above, a View Package is created entirely from data contained in a *Revisable IETM Data Base* (IETMDB), which is a complete collection of Data Elements relating to a weapon system or other equipment acquired by the Government and constructed in a standardized procedure in order to provide the following capabilities:

- a. Government activities or DOD Contractors concerned with logistic support for the weapon system involved can access the Data Base directly to obtain needed logistic-support information for specific purposes.
- b. The IETMDB can serve as the basis for construction and update of the entire suite of electronically displayed interactive weapon-system Technical Manuals through the use of automated authoring systems.

- c. The IETMDB can serve as the basis for fully automated construction, by either a Contractor or a Government Activity, of View Packages, which are increments of interactive electronically presented logistic-support Technical Information.
- d. Required portions of the IETMDB can be interchanged by means of standardized procedures throughout the DOD and its supporting Contractors on a real-time basis when needed.

2.1.4 The Electronic Display System (EDS)

The EDS is a computer-based Technical Information system designed to accept, process and integrate Technical Information for prime-equipment logistics support, and display that information to users. The EDS is also intended to support inquiries by users (in addition to Operations and Maintenance users) who have such responsibilities as supply, training, field-data collection, readiness measurement, operations scheduling, maintenance planning, maintenance quality control, and hardware configuration control. The software supporting the EDS will also be required to support additional (as yet unspecified) functions in the future, which will emerge as technologies and standards evolve. Specifically, the EDS is intended for use:

- a. In maintenance Work Centers and shops to support Troubleshooting and Planned and Corrective Maintenance;
- b. In portable form at remotely located maintenance sites;

- c. Embedded in a weapon-system control panel as support both for System operation and System maintenance;
- d. In presenting operating and maintenance information during personnel training courses;
- e. In a variety of centers and offices in support of System-related, logistics-supported functions which require Technical Information.

The Electronic Display System will consist of one or more computer-controlled Devices which display the required Technical Information by means of a screen (such as a cathode-ray-tube or a plasma display) either in a pre-ordered sequence or in random-access increments, as called for by the user; e.g., a maintenance technician. To accomplish this display, the IETM, consisting of the Technical Information recorded on a suitable medium (e.g., on an optical disc), is designed to be loaded into the EDS, "read" by this Device, and displayed in a sequence as directed by the user.

The IETMs to be used by this Display System must accordingly be so constructed as to assure full compatibility with the operating software of the Display Device, and must be tested by the preparing Contractor on such a Display Device prior to delivery.

2.1.5 Summary

As noted, all IETMs:

- a. Will be constructed through the use of an automated authoring system, and will consist of task-related increments referred to as View Packages;
- b. Will be based on an automated system Data Base, the IETMDB, prepared by the System Prime Contractor for delivery as such to the Government, retention for his own use, or both;
- c. Will consist of a digital data stream recorded on an optical or magnetic medium, but not paper, electronically displayed by the Electronic Display System in terms of text and graphics;
- d. Will be optimally formatted and styled for screen presentation (i.e., "frame oriented" rather than "paper oriented").
- e. Will be constructed for electronic display on a highly interactive Electronic Display System, which will support related logistic-support functions and which may be networked for interface with other Service Information Management Systems.

2.2 IETM PROCUREMENT OPTIONS

Logistic-support procedures for weapon systems and related equipment differ to some extent among the Services. A certain amount of necessary variation in the acquisition procedures involving the VPs, the IETMDB, and the EDS has been provided in the system of Specifications and Acquisition Handbooks developed by the IETM Working Group.

Thus, these Specifications and Handbooks detail several optional approaches in the acquisition of IETMs. These are as follows:

- a. Using appropriate IETM Specifications, the Service may buy whatever directly-authored Interactive Electronic Technical Manuals are required. Although the Author (equipment Prime Contractor) will need to establish an automated equipment or weapon-system (source) Data Base, this Data Base will not be acquired by the Government, but will be maintained and used by the Contractor, both for the preparation of IETMs and for other purposes.
 - (1) As an option, the Government might contract for on-line access to technical portions of this Contractor-owned Data Base. In such a case, both content and accessibility aspects of the IETM Data Base would have to be constructed to standard requirements.
- b. Acquisition by the Government of directly authored IETMs (fully prepared and validated by the Contractor) as well as the IETM Data Base upon which they are based. Government acquisition of the IETM Data Base may involve either of the following options:
 - (1) Delivery to the Government in standardized form and subsequent maintenance by the Government (with or without update information supplied on a continuing basis by the Contractor);
 - (2) Title acquired to the IETM Data Base by the Government, but with the Data Base retained and

maintained in the Contractor's plant. The Government to be provided with on-line access to the Data Base.

- c. Based on acquisition of the IETM Data Base, using either option b.(1) or b.(2), preparation of View Packages using either a fully automated process or one which is essentially fully automated. View Packages could be prepared either:
 - (1) By the Contractor [based on Data-Base acquisition option b.(1)], and delivered as such to the Government, or
 - (2) By the Government [based on Data-Base acquisition option b.(2)].

2.3 SUMMARY AND PURPOSE OF THE DRAFT ACQUISITION SPECIFICATIONS AND HANDBOOKS PREPARED BY THE TRI-SERVICE IETM WORKING GROUP

As noted, five draft Specifications and Handbooks have been prepared, and circulated widely for DOD and Industry comment, to provide System Acquisition Managers with the necessary contractual documentation for acquisition of Interactive Electronic Technical Manuals, the associated Data Base, and the necessary Electronic Display Systems. These statements of requirements are preliminary and will certainly be modified as experience is gained with the acquisition, management, and use of this type of Technical Information, as the technology advances, and as the Department of Defense

improves its in-house logistic-support infrastructure for support of IETMs.

The five draft Specifications and Handbooks prepared by the Inter-Service IETM Working Group (of which Appendix A of this Report is one), together with individual statements of the purpose of each document, are as follows:

2.3.1 The Revisable IETM Data Base Specification

2.3.1.1 Title

Draft MIL-D-IETMDB. *Revisable Data Base for Support of Interactive Electronic Technical Manuals (IETMs)*.
1 June 1990.

2.3.1.2 Purpose

This Specification contains the requirements for a Revisable Interactive Electronic Technical Manual Data Base (IETMDB) to be constructed by a weapon-system Contractor. This non-redundant and neutrally formatted Data Base is intended to be the single source of data for all Technical Manuals to be used in support of a given weapon system, or other equipment being acquired by the Government. This Specification may be used in two primary modes:

- a. as a set of standard requirements to which the Contractor must adhere in the development and

maintenance of his internal Data Base for subsequent conversion to Government-deliverable form; and

- b. as a set of requirements for a Data Base that is physically delivered to the Government, or is maintained by the Contractor on behalf of the Government.

2.3.2 The IETM General Content, Style, Format, and User-Interaction Requirements Specification

2.3.2.1 Title

Draft MIL-M-GCSFUI. Manuals, Interactive Electronic Technical: General Content, Style, Format, and User-Interaction Requirements for. 1 June 1990.

2.3.2.2 Purpose

This Specification contains common requirements for the Content, Style, Format, and User-Interaction features required for Interactive Electronic Technical Manuals and the operating software of the devices upon which they are viewed. These IETMs are to be delivered to the Government in digital form and must be designed for interactive display to the maintenance-technician end-user by means of a computer-controlled Electronic Display System. The range of IETMs for which general requirements are described in this Specification will cover the maintenance, diagnostic, training, system-operation, parts-information, and installation functions which are

required to achieve and maintain full operational capability of a specific weapon system or other military equipment.

2.3.3 The IETM View Package Handbook

2.3.3.1 Title

Draft MIL-HDBK-IETMVP. Guidelines for Developing Specifications for Interactive Electronic Technical Manual (IETM) View Packages. 1 June 1990.

2.3.3.2 Purpose

The purpose of this Handbook is to provide guidance for the preparation of individual View-Package Specifications, so that System Acquisition Managers may define View Package Requirements quickly and effectively for the numerous different specialized increments of Technical Information which will be required. A Handbook of this type has been referred to as a meta-specification: a Specification describing how to write a View Package specification which is the end-item specification for procurement of an actual IETM.

2.3.4 The IETM QA Program Requirements Specification

2.3.4.1 Title

Draft MIL-M-IETMQA. Quality Assurance (QA) Program Requirements for Interactive Electronic Technical

Manuals (IETMs) and Associated Technical Information.
1 June 1990.

2.3.4.2 Purpose

This Specification prescribes the requirements for a Contractor's QA program for Interactive Electronic Technical Manuals (IETMs) and, where procured, the associated IETM Data Bases and supporting View Packages. The requirements herein cover the QA process and present the plan for implementing it, from planning through final submission of the delivered product for acceptance; they apply as well to changes and revisions thereto.

2.3.5 The Electronic Display System Handbook

2.3.5.1 Title

Draft MIL-HDBK-EDS (Navy). ***Electronic Display System (EDS) for Interactive Electronic Technical Manuals (IETMs).*** 1 June 1990.

2.3.5.2 Purpose

This Handbook describes the basic functional requirements for an Electronic Display System (EDS) designed to display Interactive Electronic Technical Manuals (IETMs). It establishes the minimum system requirements to be used in a detailed Specification for competitive procurement, either for portions of the full requirements or tailored to suit the application, user environment, device compatibility, and interfaces to existing computer systems.

The requirements described in this Handbook are of three types:

- a. Those which describe the Electronic Display System hardware;
- b. Those which describe the EDS software of the display System for system operation, IETM applications, and utility functions.
- c. Those which specify the minimum performance of the several individual Display Devices which constitute the EDS.

To achieve full compatibility of the EDS with the IETMs and View Packages, the Display System Software (as well as the View Package) must also be constructed in compliance with MIL-M-GCSFUI.

Each of the three Services has its own strategies for developing Specifications and Standards for an Electronic Display System. This Handbook presents the existing Navy concepts, and is accordingly identified as a Navy-only document. Proposed concepts of the other Services which do not differ extensively from requirements described in this Handbook will be included in succeeding versions of the Handbook.

2.4 RELATIONSHIP OF MIL-M-GCSFUI TO OVERALL SET OF IETM ACQUISITION SPECIFICATIONS AND HANDBOOKS

For any given weapon system or piece of complex equipment, different View Packages, each pertaining to specific tasks or

sets of related tasks, will be required. Acquisition of each of these will require preparation (by the System Acquisition Manager) of a View Package Specification [for which guidance is given in Ref (10)]. However, many of the Content, Style, Format, and User-Interaction requirements for these View Packages will be common to all or most of them. MIL-M-GCSFUI, accordingly, provides a compendium of all such Standard Requirements for View Packages, to serve as a single citable source of such requirements for use by preparers of VP Specifications. [Ref (10) describes preparation of statements of VP requirements which are unique to individual VPs.]

In an IETM, the final presentation to the user is a combination of the information that is loaded into the EDS (i.e., the View Package) and the computer intelligence of the EDS itself (most of which is in the operating software of the EDS). It is critical that the View Package and the operating software of the EDS are designed to operate together. To do this the EDS and the VP must be designed to the same specification for Formatting and User Interaction. Thus, a key additional role of the MIL-M-GCSFUI Specification is to serve as the guide that the software developer uses in creating the operating software for the EDS upon which the VP will eventually be displayed.

The proper interaction of the VP and the EDS must be assured in the writing of the VP Specification, and this, in general, will be accomplished by the VP Specification requiring that the VP operate on (and be validated on) an EDS that has been designed to be in conformance to the MIL-M-GCSFUI Specification.

3.0 SUMMARY OF MIL-M-GCSFUI,
*Manuals, Interactive Electronic Technical: General Content,
Style, Format, and User-Interaction Requirements for.*

3.1 GENERAL REQUIREMENTS FOR IETMs AND VIEW PACKAGES

Logistic support for complex weapon systems, for air, sea, and land vehicles, or for other equipment acquired by the Department of Defense, may require the acquisition of many and varied packages of Interactive Electronic Technical Information referred to as View Packages. As noted in Sec 2.4, acquisition of each of these View Packages will require preparation by the System Acquisition Manager of a Specification detailing the functional requirement for the IETM, the technical content of the VP, the supporting content requirements for the VPs, and the Style, Format, and User-Interaction features of the View Package. These requirements must be carefully developed, standardized, and worded so that an equipment Prime Contractor can generate the VP in such a way that it can most effectively aid Service personnel in performing some aspect of system support when displayed on an Electronic Display System.

To meet this overall requirement, it is critical to standardize to as great an extent as possible the User-Interaction features of the VP. This is necessary to acquire View Packages which are capable of being tested and displayed on a standardized Electronic Display System which must, through its operating software, permit the user to exercise these features, must give him control over the sequencing and mode of presentation of the Technical Information, must allow him to use the displayed TI for accomplishment of related functions (e.g., maintenance action reporting), and must permit him to

input information into, and to ask questions of, the VP/EDS combination (i.e., the IETM).

In addition, the Content, Style, and Format features of the VP, as well as the formatting and user-interaction features of the EDS, should be made as nearly standard as possible, both for the sake of the use by and the training of the end user and for the sake of the Industry which creates the VPs.

Many of these requirements will be capable of essentially complete standardization (e.g., it is highly desirable that text-graphics combinations are displayed by the Electronic Display Systems in as consistent a form as possible). Other requirements will be determined by the type of Technical Information being presented by a given view Package (e.g., procedural information or troubleshooting) and thus will be common to all VPs which contain such information.

Still other additional requirements for Content, Style, and Format may be unique to an individual VP and these will be iterated in the VP Specification and are not included in this general specification.

MIL-M-GCSFUI presents a compendium of the Content, Style, Format, and User-Interaction requirements which will be common to essentially all VPs, as well as those requirements which must be invoked by the System Acquisition Manager to support the most common specific types of Technical Information presentation.

Preparation of unique VP requirements (and the integration of the complete VP Specification) are described in Ref (10).

3.2 GENERAL CONTENT REQUIREMENTS

As used in MIL-M-GCSFUI, the term General Content Requirements refers to requirements for those Content elements needed in any IETM to assure effective presentation and utility of the Technical Content of the IETM View Packages. Examples of such requirements are those for:

- a. Help Information in support of the technical content.
- b. Precautionary Information (Warnings, Cautions, and Notes).
- c. Administrative Information (such as the name of the preparing Activity, the date of issue, the VP number, and resupply data).
- d. Applicability Statement (identifying the specific equipment and range of serial or model numbers, to which the VP is applicable).
- e. Introduction to the VP (scope, purpose, limitations, range of tasks included, and the like). The Introduction material will also identify support equipment, tools, and other materials required by the tasks covered by the VP.
- f. List of Contents; for example, for a Corrective Maintenance VP, the list of maintenance tasks included. (This Content item is analogous to a Table of Contents,

but with access and sequencing adapted to the interactive mode of presentation used in IETMs and with multiple access by the user.)

- g. A Look-Up Index: a Content element permitting a user, either directly or by use of menu sequences, to bring to the screen individual items of Technical Information by entering such designations as part name, part number, system nomenclature, task name, NSN.
- h. How-to-Use-This-VP Information. Every IETM increment must contain information of the Help type, providing guidance for the user as to how to use the VP/EDS in obtaining an effective display of the particular View Package.
- i. Definitions of acronyms and unusual terms in the textual portion of the VP.

MIL-M-GCSFUI also provides guidance as to how these generally applicable Content elements are to be presented to the VP user. Establishment of detailed requirements of the actual Technical Content (e.g., which specific tasks are to be included in a VP), which is usually highly related to the nature and purpose of the individual VP, are, as noted, dealt with in Ref (10), the VP Handbook.

3.3 GENERAL STYLE REQUIREMENTS

MIL-M-GCSFUI presents general style requirements for IETM View Packages, both for text and for graphics. The term Style

refers to those aspects of information presentation dealing with details of textual construction, forms of expression (e.g., sentence length), spelling, capitalization, permissible words, punctuation, and the like.

It also refers to aspects of Graphics Style such as level of detail to be provided, illustration quality and density, design of callouts, size of alphanumeric symbols on graphics, and the like.

The fundamental objective in the establishment of all Style requirements is the improvement of comprehensibility of the Technical Information, with an important secondary objective of improving ease and efficiency of use by the end user. Many considerations presented in MIL-M-GCSFUI might be equally applicable to paper Technical Manuals; but many other requirements, particularly those dealing with the display of text/graphics combinations, have been established particularly to improve the interactive electronics presentation of Technical Information.

The detail in this specification is intended to be complete and comprehensive so that no additional reference is made to existing paper-medium style guides.

3.3.1 Summary of General Style Requirements

Those Style requirements for textual and graphical Technical Information contained in VPs, which supplement or modify such information normally contained in Paper TMs, address the following:

- a. The need to strike a careful balance between too little and too much detail in presenting Technical Information in either text or graphics. IETMs will have less words and more pictures.
- b. The need to keep sentences short and directive, with the avoidance of complexity, in either sentences or paragraphs. This requirement is of great importance in the design of "frame-oriented" TI for interactive display.
- c. The use of only those words on Word Lists specified or provided by the Government as part of the contract. Such Word Lists may be tailored to the individual needs of the Services, and will contain:
 - (1) A list of several thousand "common", or basic, words;
 - (2) Shorter lists of words peculiar to a given technology or activity peculiar to the IETM functional requirement (e.g., "avionics", "ship operation");
 - (3) A short list containing words applicable only to the system under consideration.
- d. Directions for nomenclature of systems, subsystems, components, and parts, for both text and graphics.
- e. Requirements governing units of physical quantities;
- f. Requirements governing numerical values and tolerances;

g. Style requirements for graphics (Sec 3.2.3 of MIL-M-GCSFUI) dealing with types of graphics applicable, and the quality and design of the alphanumeric symbols used to carry information in screen presentation. Requirements for actual arrangement or layout of a screen containing text and graphics are covered under the Sections on General Format Requirements (see Sec 3.4 of this report).

3.4 GENERAL FORMAT AND USER-INTERACTION REQUIREMENTS FOR IETM DISPLAY

As noted, the design of the screen or frame in interactive electronic presentation of a View Package is of vital importance in providing the most effective display. The MIL-M-GCSFUI requirements for the screen formatting and display and those User-Interaction functions applicable to control of the display and navigation through the displayed information are highly interrelated (e.g., the use of windows, menus, controls, and user-EDS dialogue). They are, however, discussed in the specification in two sections, one of which describes the requirements for a standard Graphic User Interface (GUI) (including the display windowing manager) applicable to all and any computer applications displayed on the EDS, and the second section describes those IETM peculiar requirements which are displayed in what is called the Client Area of the standard Graphic User Interface.

Thus, as part of the statements of requirements for Format/User-Interaction of the IETM, MIL-M-GCSFUI provides detailed requirements for:

- a. Cursor/display interaction;
- b. Establishment and control of Windows, and the display of information in Windows;
- c. The use of a title bar (for running identification of displayed information);
- d. An Alert Window (e.g., for Warnings and Cautions);
- e. Scrolling;
- f. Establishment, design, and control of several types of menus, including use of a menu bar at the top of every frame and a standard Help menu;
- g. Design and function for "Dialog Boxes" displayed by the screen, which contain data entry features and graphical controls called "buttons" which are available to the user for making selections from the screen display;
- h. Functions such as Highlighting of text, color, display of items at various luminance levels, image reversal;
- i. Zoom;
- j. Design and content of Tables;
- k. Design and capability of user prompts;
- l. Use of audio (non-verbal and computer-generated voice);
- m. Use of video sequences;
- n. Graphics motion and animation.

3.4.1 Summary of User-Interaction Functions Related to IETM Display

MIL-M-GCSFUI summarizes the requirements for required and optional user-interaction functions which are directly related to control of the IETM display format. This section outlines minimum functionality (e.g., next, retrace, bookmark) and sets guidelines for the naming and behavior of many optional functions, which might be invoked by an Author or implemented in an application program by a computer Software designer.

3.4.2 Screen Formatting

MIL-M-GCSFUI provides for five alternative screen arrangements ("templates"), one for all text, and four for combinations of text and graphics (Sec 3.4.1). This Section presents standard requirements for headers; footers; display of Warnings, Cautions, and Notes; borders; and the like. Detailed requirements for formatting locator illustrations are provided in Sec 3.4.2.7; Sec 3.4.2.8 states requirements for callouts.

3.5 GENERAL CONTENT, STYLE, AND FORMAT REQUIREMENTS BASED ON TYPE OF INFORMATION PRESENTATION USED IN VIEW PACKAGES

General requirements for Content, Style, and Format are often common to a specific mode of information presentation rather than to an entire class of View Packages. For example, MIL-M-GCSFUI includes the requirement that, in presenting procedural information, text must always be presented in the imperative voice.

In Section 3.5, MIL-M-GCSFUI summarizes requirements specifically related to the following types of information presentation:

<u>TYPE OF INFORMATION</u>	<u>SPECIFICATION</u>
	<u>SECTION</u>
Procedural Information	3.5.1
Troubleshooting Information	3.5.2
Parts Information	3.5.3
Descriptive Information	3.5.4
Operational Information	3.5.5

Requirements involving procedural information, discussed in some detail, are:

- a. The organization of maintenance or other tasks into steps.
- b. The requirement for a detailed description of Initial Setup requirements for a given task (Sec 3.5.1.4.2).

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APPENDIX A

*Copy of Draft Military Specification
MIL-M-GCSFUI. Manuals, Interactive Electronic
Technical: General Content, Style, Format,
and User-Interaction Requirements for.*

1 June 1990.

Prior to the publication of this report the document included as Appendix A has been officially submitted to the DOD Defense Quality Standardization Office and the DOD CALS Policy Office by the Office of the Chief of Naval Operations, Code 403 - Logistics Policy (OPNAV LTR 4160 Ser 403T/OU593187 dtd 4 Jun 1990). It has also been submitted to the Pageless Technical Manual Working Group of the Aerospace Industry Association for Review and Comment. This document was distributed as a review draft and is largely a DTRE product with assistance from the Air Force as noted. This Appendix is in the exact form that was submitted to these organizations.

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NOTE: This draft, dated 1 June 1990, prepared by DTRC/AFHRL/AFLC, has not been approved and is subject to change. DO NOT USE FOR ACQUISITION PURPOSES.

*****REVIEW DRAFT*****

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: David Taylor Research Center, Code 182.3, Bethesda, Maryland 20084-5000.

MILITARY SPECIFICATION

MANUALS, INTERACTIVE ELECTRONIC TECHNICAL: GENERAL CONTENT, STYLE, FORMAT, AND USER-INTERACTION REQUIREMENTS

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MILITARY SPECIFICATION

**MANUALS, INTERACTIVE ELECTRONIC TECHNICAL: GENERAL CONTENT,
STYLE, FORMAT, AND USER-INTERACTION REQUIREMENTS**

1 SCOPE.

1.1 Scope. This specification contains common requirements for the content, style, format, and user-interaction features which are required for Interactive Electronic Technical Manuals (IETMs) which are to be delivered to the Government in digital form and which are designed for interactive display to the maintenance-technician end-user by means of a computer-controlled Electronic Display System (EDS). The range of IETMs for which general requirements are described in this specification will cover the maintenance, diagnostic, training, system-operation, parts-information, and installation functions which are required to achieve and maintain full operational capability of a specific weapon system or other military equipment.

1.2 Nature of the All-Digital Data Stream for an interactive electronic technical manual (IETM). An IETM for which general content, style, format, and user-interaction requirements are detailed in this specification, is to be:

- a. Prepared by the contractor using an automated authoring system (computer-controlled workstation);
- b. Delivered to the Government in digital form (after validation; verification; and, if required, prepublication review) for storage in a computer-controlled database;
- c. Distributed to end users on a suitable medium, such as optical disc; and
- d. Viewed by a technician via an electronic display device.

IETM data shall be capable of automated digital interchange with other user-level information systems, such as work-center maintenance management, automated maintenance-action reporting, parts ordering, and logistics-support information systems.

1.3 Interaction of the interactive electronic technical manual (IETM) and the electronic display system (EDS). An IETM must be constructed from the outset in such a way as to assure that it is fully compatible with the operating software of the EDS, and must be tested on such a

display device (i.e., on the Government-specified device which will be used by the end user to display the IETM). Each requirement cited in this specification should have its counterpart in an EDS specification (which requires a capability the EDS designer must provide so that the IETM capabilities can be realized in displaying technical information to the user).

1.4 Nature of a view package. A view package is the computer-readable package of technical information, consisting of data extracted from an IETM data base, and designed to support some specific logistics-support function relating to a weapon system or other military equipment. The view package is composed into a comprehensible sequence of tasks, descriptive elements, or other maintenance-support information constituting an increment of the technical information needed to maintain, support, and operate a weapon system, and is formatted and arranged for electronic display presentation. View packages must conform to the requirements of this specification.

1.5 Use of this specification. This specification is intended for use by reference in a competitive procurement in which the Government acquires specific IETM View Packages to support some logistics-support function (e.g., maintenance, training, or system operation) of a weapon system or other military equipment. This specification describes the requirements the author of the IETM must follow concerning the creation and selection of general content, style, format and user-interaction features of the IETM. This specification is intended to be implemented in combination with specific requirements or end-item specifications which in turn reference this specification for IETM details common to the differing end-item specifications.

1.6 Types of requirements covered by this specification. This Specification provides requirements for the general content, style, format, and user-interaction of the IETM. The delivery medium and the physical nature of the digital data stream to be delivered to the Government is not described in this specification. Since the IETM conforming to this specification will be designed to be viewed through use of an interactive computer-controlled EDS, the style, format, and user-interaction requirements are significantly different from those of ordinary paper-based Technical Manuals. This specification covers general requirements for IETMs in four categories:

- a. Content
- b. Style
- c. Format
- d. User-Interaction features

These four types of requirements are detailed as follows:

1.6.1 General content requirements. This specification provides general statements defining content requirements common to IETMs (Section 3.1). Content statements may be classified as:

- a. those applicable to construction of the IETM such as dealing with the IETM technical structure and those required to support use of a particular IETM or view package (e.g., Help information).
- b. those applicable to specific technical processes to assure effective use of the IETM for the logistic-support purpose intended.

1.6.1.1 Common content requirements for IETM structure and supporting information. Common content requirements for IETM structure require the incorporation of such features as front (introductory) matter, List of Contents, index, glossary, List of Acronyms, Statement of Applicability, IETM number, IETM date, IETM edition, and many others. General requirements for support of IETM or view package usability detail the need for inclusion of such standard elements as help information, inclusion of a look-up index, definitions of acronyms and unusual terms, and the like.

1.6.1.2 Content requirements related to technical functions. This type of requirement involves standardized increments of technical content needed to ensure that the technical information presented in support of a given process is complete, comprehensible, and effective. For example, the requirement that location drawings be incorporated to assist the user in remove-and-replace operations, or the requirement that setup information be incorporated for all system-related procedural information. Similarly, content requirements such as the standardized requirements for parts information will be detailed under this category.

1.6.2 General style requirements. As used in MIL-M-GCSFUI, the term "style" refers to two categories of requirements:

- a. The nature of the language structure (grammar and syntax) used; the vocabulary; and criteria governing technical terminology, numbers, abbreviations.
- b. The presentation related aspects of text and graphics (e.g., graphics design, callout construction, use of shading).

General style requirements are presented in Section 3.2 of this specification.

1.6.3 General format and user-interaction requirements. Format requirements deal with all aspects of the arrangement (organization) of text and graphics information for screen presentation, and with the sequencing (ordering) of frames within an increment of technical information. General format and user-interaction requirements of the common user interface are presented in Section 3.3 of this specification.

1.6.4 General user interaction requirements. General requirements for user-interaction capabilities required for interactive presentation of IETMs and view packages (requirements which, as noted, must be reflected in the EDS) are of two types:

- a. Those user-interaction functions needed to control a screen display (e.g., Windowing, Zoom, and Scroll);
- b. Those user-interaction functions which are required for the user to interact with the IETM and to obtain information from it (e.g., Help, Notepad, Call, Select).

The detailed requirements for format and user interaction are presented in Section 3.4 of this specification.

1.6.5 Requirements based on types of information. Selection from this specification of applicable general requirements for content, style, format, and user-interaction by the preparer of a specific IETM View Package specification will require additional detail based on an assessment of the types of information to be contained in the IETM. Types of information include the following:

- a. Procedural Information
- b. Descriptive Information
- c. Operational Information
- d. Troubleshooting Information
- e. Parts Information

An individual IETM may contain technical information from any of these information categories. However, many of the general content, style, format, and user-interaction requirements will apply to most of the information categories presented in this specification. Requirements very specific to the individual information type will be addressed in an individual IETM View Package specification written in accordance with MIL-HDBK-IETM.

1.7 Generation of the IETM data. In order to assure conformity to the requirements of this specification, IETM data will, in general, have to be generated by use of an automated authoring system. This authoring system should have the capabilities listed below.

This section is included herein for guidance to the Contractor preparing the IETM View Package and is not listed as a specific contractual requirement. The Government does not intend to specify or require a particular authoring system to be used by a contractor in generating IETMs. In addition, MIL-Q-IETMQA, *Quality Assurance Program Requirements for Interactive Electronic Technical Manuals and Associated Technical Information*, specifies minimum features of the Contractor's authoring system which are required to be included in the Contractor's Quality Assurance Plan.

It is suggested that a Automated Authoring Capability should have, at a minimum, the following capabilities.

- a. Direct communication with source information databases, such as the Logistics Support Analysis Record (LSAR) per MIL-STD-1388/2, and system design and production databases, permitting direct transfer of text and graphics information to the author's terminal on request.
- b. Incorporation of a complete text-graphics merge capability.
- c. Incorporation of certain support capabilities, such as:
 - (1) Spell-checking;
 - (2) Comparison of generated IETM data with permissible word lists, if required; and
 - (3) Syntax control features, such as automatic flagging of instances of passive voice and compound sentences.
- d. The ability to directly view data as it will be displayed by the EDS, referred to as "What-You-See-Is-What-You-Get" (WYSIWYG) capability.
- e. The ability to exercise all calling functions of the EDS via keyboard or position indicator, such as a touch screen, from the author's terminal.
- f. Zoom, scroll, and windowing capability to the extent that the EDS exercises these functions.

1.8 Paragraphs with limited applicability. This specification contains paragraphs and specific requirements which are not applicable to all Services. Such paragraphs or requirements are prefixed to indicate the Services to which they pertain: (A) for Army; (N) for Navy; (M) for Marine Corps; and (F) for Air Force.

2 APPLICABLE DOCUMENTS.

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards form a part of this specification to the extent specified herein. Specifications and standard issues shall be those listed in that issue of the Department of Defense Index of Specifications (DoDISS) specified in the applicable contract.

SPECIFICATIONS

DOD-D-1000B Drawing, Engineering, and Associated Lists

MIL-D-EDS Electronic Display System (EDS) for Interactive Electronic Technical Manuals

MIL-M-IETMQA Quality Assurance Program Requirements for Interactive Electronic Technical Manuals and Associated Technical Information

MIL-H-46855 Human Engineering Requirements for Military Systems, Equipment, and Facilities

STANDARDS

MIL-STD-12 Abbreviations for Use on Drawings, Specifications, Standards, and in Technical Documents.

MIL-STD-100 Engineering Drawing Practices

MIL-STD-106 Mathematical Signs and Symbols for Use in Physical Sciences and Technology

MIL-STD-875 Type Designation for Aeronautical and Support Equipment.

MIL-STD-1388/1 Logistic Support Analysis

MIL-STD-1388/2 Logistic Support Analysis Record, DOD Requirements for a

MIL-STD-1472 Human Engineering Design Criteria for Military Systems, Equipment, and Facilities

2.1.2 Other Government publications. The following other Government publications form a part of this specification to the extent specified herein.

PUBLICATIONS

MIL-HDBK-59 DOD Computer-Aided Acquisition and Logistic Support (CALS) Program Implementation Guide

MIL-HDBK-IETM Preparation of View Packages in Support of Interactive Electronic Technical Manuals

U.S. Government Printing Office Style Manual: Library of Congress Catalog Number 2253.U58.

Joint Chiefs of Staff (JCS) Publication 1: Dictionary of U.S. Military Terms for Joint Usage.

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those

listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents are not listed in the DODISS are the issues of the document cited in the solicitation.

PUBLICATIONS

American National Standards Institute (ANSI):

ANSI Y10.5 Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

ANSI Y10.19 Letter Symbols for Units Used in Science and Technology

ANSI Y14.2 Line Conventions and Lettering.

ANSI Y14.5 Dimensions and Tolerances.

ANSI Y14.15 Electrical and Electronics Diagrams.

ANSI Y32.14 Graphic Symbols for Logic Diagrams (Two-State Devices).

ANSI Y52.2 Graphic Symbols for Electrical & Electronic Diagrams

(Applications for copies should be addressed to
The American Standards Institute, Inc.,
1430 Broadway, New York, NY 10018.)

Institute of Electrical and Electronic Engineers (IEEE):

IEEE Std. 200 Reference Designation for Electrical and Electronics Parts and Equipment.

IEEE Std. 315 Graphic Symbols for Electrical and Electronics Diagrams, Including Reference Designation Class Designation Letters.

(Applications for copies should be addressed to the
Institute of Electrical and Electronic Engineers,
345 E. 47th St., New York, NY 10017.)

Aerospace Industries Association PUBS-119, Publications:

DOD Liaison Recommendation for Hazardous Materials Warnings in Technical Data

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets or MS standards), the text of this document shall take precedence. Nothing in this

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document, however, supersedes applicable laws and regulations unless a specified exemption has been obtained.

3 REQUIREMENTS.

3.1 General content requirements. This section presents general content requirements, both for technical information which must be incorporated as part of an IETM, and for technical information which must be incorporated to support use of a particular IETM or view package.

3.1.1 General content requirements related to technical functions. The following sections on level of detail, help information, and precautionary information relate to aspects of the technical function of the IETM which apply to all information types.

3.1.1.1 Level of detail. Technical information shall contain all of the information necessary for a user to perform the task involved or to comprehend a description. This level shall be defined by the acquiring activity. The IETM shall not contain unnecessary detail above or below this level, while retaining enough information to permit the user to perform maintenance without error and in a minimum of time.

3.1.1.1.1 Procedures within steps. When a general purpose procedure, such as "Apply electrical power," is referenced by a step, the user shall be given the option either to access the procedure before continuing with the current task or to bypass the procedure. When a procedure is peculiar to a task, or involves use of a peculiar piece of equipment, it shall be included in the procedural data.

3.1.1.1.2 Multiple levels of detail. If required by the procuring activity, technical information shall be presented in two levels of detail: one level for a novice and another for an expert. The novice level shall contain all information necessary for an inexperienced user to perform the task involved or to comprehend a description. The expert level shall resemble a checklist, presenting only the steps required to complete a task or providing a description in broader terms, requiring a higher level of theoretical knowledge. Both levels shall contain all pertinent safety information. The expert user shall be given the ability to access information at the novice level but the novice shall not be able to access to the expert level.

3.1.1.2 Help related to technical content. The user shall have access to additional help information relating to the technical content of the IETM such as information on the weapon system or assistance in using one of the special features of the authored procedures for that particular weapon system. The help function shall also permit the user to access context-sensitive help which applies to the user's current activity and situation. It shall permit the user to access descriptive information which further explains some technical point which may be expected to be unusually difficult for users, to define a specific term, or to provide a fuller explanation of some process covered very briefly by the technical information. Help information shall be available for all

selections of the IETM other than an introduction/overview of the program.

3.1.1.3 Precautionary information. Technical information must be presented in such a way as: (1) to attract the user's attention to practices, procedures, and conditions which could lead to injury or equipment damage; (2) to warn the user against performance of certain hazardous actions; and/or (3) to require specific steps leading to safe performance of the procedure. Procedures prescribed for the operation and maintenance of equipment shall be consistent with the safety standards established by the Occupational Safety and Health Act, Public Law 91-596, and Executive Order 11807. Appropriate precautionary requirements shall be included when it is impossible to avoid use of or exposure to hazardous chemicals, adverse health factors in the environment, or hazardous equipment. Critical safety information or other information to be highlighted shall:

- a. Be integrated with the material to which it applies;
- b. Be apparent to the user;
- c. Contain all necessary information to reduce or alleviate the hazard;
- d. Be easy to read and understand in the work environment available.

3.1.1.3.1 Definitions of warning, caution, and note. The terms warning, caution, and note are defined as follows:

- a. **WARNING:** Calls attention to possible personal injury, loss of human life, or a long-term health hazard unless indicated procedures are followed and identified safety precautions observed.
- b. **CAUTION:** Calls attention to possible equipment damage or destruction unless specified procedures are followed and safety precautions presented are observed.
- c. **NOTE:** Describes an unusual procedure or condition to which special attention must be paid for any reason (but it may not replace a caution or warning).

3.1.1.3.2 Text of warnings and cautions. The text of warnings and cautions shall contain the following information in the order indicated:

- a. The specific nature of the hazard;
- b. The steps to be taken to avoid or minimize the hazard;
- c. The location of the source of the hazard;
- d. The consequences of failing to heed the warning or caution.

The information shall be presented in simple words and in a straightforward, non-exaggerated manner. The information must be self-contained.

3.1.1.3.3 Text of notes. Notes shall be written in accordance with the style requirements defined in this specification. Notes shall be used to supply needed information that is not a step in the procedure. An example is as follows:

NOTE: If all excess cleaning agent is not removed before reassembly, the circuit boards may become contaminated and produce equipment malfunction.

Information presented in notes shall not contain excessive verbiage and be limited to necessary specifics. Required tolerances and clearances shall not be given as notes, but shall be included in the procedural steps.

3.1.1.3.4 Placement of warnings, cautions, and notes. Warnings, cautions and notes shall be placed at the points where they apply in accordance with the following rules:

- a. Warnings and cautions shall precede in logical sequence the display of the text or procedural steps to which they apply;
- b. Notes may either precede or follow applicable text depending on the point to be emphasized. However, in the case of a procedural step, a note shall always precede the display of the procedural step to which it applies.
- c. Warnings, cautions, and notes shall not contain procedural steps other than those dealing with hazard avoidance and/or correction.
- d. When necessary to precede text or procedural steps by a combination of warnings, cautions, and notes, order them in the following sequence: warnings, cautions, and notes.

3.1.1.4 Danger from multiple sources. When one type of danger may come from several sources or when one type of danger may require more than one remedial action, the danger may be referred to once in bold type to the right of the icon and warning label and the various alternatives listed in outline from below it. Example:

ICON	WARNING	CAUSTIC CHEMICALS IN BATTERIES
		<ul style="list-style-type: none">o Use rubber gloves and apron to avoid severe burns.o If chemicals get on your skin, clothes, or equipment, wash immediately with water.o If chemicals get in your eyes, wash them immediately with plenty of water and get

medical help as soon as possible.

3.1.1.5 Health-hazard precaution data. When hazardous chemicals or other adverse health factors are present in the environment or will appear during the performance of the procedure, and these health hazards can not be eliminated, appropriate precautionary information shall be included in the technical information. Necessary protective devices for personnel shall be listed in the Initial Setup (Input Conditions) of the procedure and referred to in the appropriate subtask steps or warning/caution message. In constructing warnings and cautions relating to hazardous substances, icons in the publication Aerospace Industries Association Pubs-119, Publications. DOD Liaison recommendation for hazardous materials warnings in technical information shall be used.

3.1.2 Common requirements for IETM technical structure and supporting information.

3.1.2.1 Administrative information. All IETMs must contain the following administrative information for user-selectable display:

- a. Identification of the technical manual (Title), and Technical Manual Number (e.g., TMINS Number);
- b. Date;
- c. Amendment or modification status;
- d. Preparing activity;
- e. Activity with technical control of the IETM;
- f. Activity responsible for configuration management of the equipment/system;
- g. Address for forwarding deficiency reports or other evaluative comments;
- h. Method of obtaining additional copies (disks).

3.1.2.2 Applicability statement. The IETM view package shall contain a highly accessible, detailed applicability statement which explicitly identifies the specific system equipment, or component, to which the IETM applies. This information shall be in addition to the use of any automated feature of the EDS which displays only that information relating to one particular configuration. If the IETM applies only to certain individual members of a class of equipment, this fact shall be stated, and relevant model numbers, serial numbers, aircraft tail numbers, and the like shall be unequivocally stated.

3.1.2.3 Introduction. All IETM view packages shall contain information which explains the IETM purpose and scope (e.g., organizational-level

troubleshooting and corrective maintenance for a particular system), content, and organization. This section shall delimit the range of tasks covered by the IETM and relate purpose and scope of the manual to the System Maintenance Plan as developed by the Logistic Support Analysis (LSA) performed for the system. It shall identify required support equipment, test equipment, tools, and materials; and indicate calling instructions for further information on these subjects as required.

3.1.2.4 List of contents. The IETM or view package shall contain a list of the contents of the IETM (i.e., if a corrective-maintenance IETM, the list of contents shall provide a list of all maintenance tasks included) and shall provide instructions for direct user access to each item at the lowest level cited. The list of contents is analogous to the table of contents of a paper manual, but sequencing shall be based on the logic of the logistics-support function covered (and may contain branching). The user shall be able to access the listed entries directly from the list of contents menu.

3.1.2.5 Look-up index. An index shall be included which identifies and provides selection instructions for all individual sections of the IETM down to the task, component, or part level, so that a user can enter the IETM and access directly the information he needs. Each item identified in the look-up index shall be listed under all common designators used (e.g., part number, nomenclature, NSN, etc.). The lookup index shall include visible indexes (which can translate into sequences of menus) for access of specific subjects or identified pieces of information in the IETM data. The lookup index shall also provide access to lists, such as list of contents, list of illustrations, and list of effective Rapid Action Changes (RACs) or Technical Directives.

3.1.2.6 "How-to-use" help information. In addition to the technical information related help described in Section 2.1.1.2, the user shall be provided with help information involving the use of the IETM itself or the use of the EDS. This help information shall:

- a. describe how to use the IETM; e.g., how to reach (access) specific information and employ user-interaction functions;
- b. summarize content of "Help" and "Comment" information.
How-to-Use-This-IETM information shall be incorporated by the IETM author into the IETM.

3.1.2.7 Instructions for interactions with IETM utility functions. Information shall be provided which describes procedures for all utility functions included as supplements to the primary function of the IETM; e.g., (1) preparation and submission of associated maintenance-action reports, (2) accumulation and submission of IETM-deficiency reports citing IETM errors or problems in using the IETM, (3) ordering of needed parts, (4) work-center maintenance management, (5) use for on-station training, (6) acquisition of additional IETM or view package discs.

3.1.2.8 Definitions of acronyms and unusual terms. Every acronym used in an IETM shall be spelled out at the first use. In addition, a special glossary with a list of definitions of acronyms (and other abbreviations) and of unusual terms shall be incorporated in the IETM. The glossary shall also contain definitions of selected terms and acronyms used in the IETM data. These definitions shall be both viewable as an individually accessible list and callable via the HELP function from the body of the IETM presentation.

3.2 **General style requirements.** This section presents general style requirements for IETMs and view packages, both for the language to be used in textual technical information and for the graphics supplementing the textual portions.

3.2.1 Comprehensibility. To ensure comprehensibility in IETM data, the following principles shall be followed in authoring technical information:

a. Provide essential information:

- (1) What is it (system, component, etc.)? Identify special or outstanding features.
- (2) What does it do? (What function does it perform?) Include inputs, outputs, interface with other systems; emphasize end results.
- (3) How does it perform its function? Include relevant principles of operation.
- (4) At what point in an overall system process does it function? (When does it perform its function?)
- (5) Where is the component or part of interest located?

b. When combined with illustrations, the text may use an abbreviated sentence style as follows:

- (1) Articles may be dropped.
- (2) Sentences may begin with active verbs. (Use active voice throughout; no passive.)
- (3) Subjects may be implied.

c. When it is necessary to indicate time, begin sentences with "when" clauses. Example: "When power supply voltage has reached stability..."

d. Limit paragraphs to a single idea. Limit sentences to a single thought; use no compound or complex sentences. Limit words to those that are short and familiar and, except in rare cases, those that are on permitted word lists.

- e. Except in unusual circumstances, construct explanations as fully integrated text-graphics modules. Key the explanatory text to the illustration.
- f. Present descriptive text in a logical order (e.g., in operational sequence or in signal-flow sequence).
- g. Keep descriptive text consistent in terminology, style, and format throughout IETM data. Start sentences with either all verbs or all nouns. Use parallel sentence construction.
- h. Eliminate long, complex sentences and paragraphs through the use of lists. The resulting parallel portions of sentences shall be individually listed as follows:

The beat frequency oscillator has three components:

- (1) ...
- (2) ...
- (3) ...

- i. Do not exceed an average sentence length of 20 words. The desired average is 17 words or less, but 18 to 20 words is acceptable. The average paragraph shall not exceed six sentences. The desired paragraph length is three to four sentences, but five to six sentences is acceptable. Each paragraph shall have a topic entry or sentence. All material in the paragraph shall relate to and develop the topic sentence.

3.2.2 Textual style considerations.

3.2.2.1 Language considerations. Writing shall be factual, specific, terse, clearly worded, and simply illustrated, so that a user who has the required aptitude, training, and experience will understand it.

3.2.2.2 Vocabulary (permitted words). Words used shall be limited to those contained in the permitted word lists which are specified in the contract. These lists will include:

- a. a selected vocabulary of common words;
- b. a standard vocabulary of common words specific to the particular service responsible for the IETM (e.g., Army, Navy, Air Force);
- c. words related to the specific technology involved (e.g., avionics, navigation, weapons);
- d. words related to the specific system involved.

Words initially used by the IETM author, and identified during the Contractor's QA process, which are not on these lists, shall be eliminated and replaced with "permitted" words, unless the comprehensibility of a given passage requires use of a "non-permitted" word. The Government must approve use of any "non-permitted" word. Terminology must be used consistently; e.g., the same word for a given tool must be used throughout the IETM.

3.2.2.3 Sentence and paragraph structure. Sentences should not exceed 20 words in length. Paragraphs should not exceed 60 words in length. Each paragraph shall have a topic entry or sentence. All material in a paragraph shall relate to and develop the topic sentence. Compound and complex sentences shall not be used. Exceptions to this requirement shall require the approval of the acquiring activity.

3.2.2.4 Use of imperative voice. The second person imperative voice shall be used in presenting procedural technical information. Examples:

Set POWER SCAN control (5) to ON.

Remove special locking nut (2) and washer (3).

Set outer knob to +INT.

Make sure the POWER is OFF before beginning this Task.

3.2.2.5 Proper amount of technical information. During the writing process, the IETM author shall exercise judgment in providing all required technical information needed by a technician without inserting extraneous material. If at IETM validation, it is found that the technical information is not adequate for the validator to do the task the first time without error, then additional or alternative technical information is required. Similarly, material which has been included, but which the user does not require to accomplish the task shall be identified and eliminated.

3.2.2.6 Nomenclature. Nomenclature used for names of equipment item assemblies, parts, etc., shall be in agreement with the approved nomenclature list prepared as part of the Logistic Support Analysis Record (LSAR). Use of this nomenclature or any other standard shortened identifier (e.g., acronym) shall be consistent throughout the entire IETM and among all IETMs which apply to the weapon system involved.

- a. Each tool, item of test equipment, item of support equipment, part, component, etc., shall be assigned a single suitable name, which shall be used verbatim whenever the item is cited throughout the technical information.

b. All nomenclature used in text shall be identical to the nomenclature for the corresponding item on related graphics.

3.2.2.7 Articles. Articles (a, an, the) shall in general be used in descriptive text. They may be eliminated in procedural technical information when such a practice would not interfere with comprehensibility.

3.2.2.8 Abbreviations. Use of abbreviations (including abbreviations for common units) shall be held to a minimum and each abbreviation shall be defined in the glossary of the associated IETM. An abbreviation shall be spelled out the first time it is used in the IETM. Abbreviations shall be in accordance with MIL-STD-12.

3.2.2.9 Consistency of units. IETM data shall be consistent in the unit of measure used. Units of measure shall be used for:

- a. Temperature readings as marked on the equipment. If other than Fahrenheit, the equivalent in Fahrenheit shall follow parenthetically. General temperature references, such as room temperature, shall normally be given in degrees Fahrenheit.
- b. Speed, distance, and meter readings as marked on the equipment. When the metric system is used on the equipment, conversion to U.S. standards shall follow in parentheses. If required by the contract, conversion of U.S. measurements to metric measurements shall follow in parentheses.
- c. Switch positions and panel markings exactly as marked on the equipment. However, symbols on panel markings, such as the symbols for "ohm" or "infinity," may be spelled out in textual references or when they cannot be produced by the presentation system.
- d. If not otherwise specified on the equipment, measurements shall be in U.S. standard units (ounces, pounds, gallons, inches, feet, knots, miles, etc.).

3.2.2.10 Numerical values/tolerances. For numerical data, all measurement values shall have tolerances given in the form of a range of values. For example,

128 (125 to 129),

where 128 is the desired value; or

125 to 129,

where there is no desired value. The \pm (plus-or-minus) symbol shall not be used. Tolerances shall not be expressed in percentages. All numerical values shall be given to the number of decimal places readable

on the instruments provided. Tolerances shall have the same number of decimal places as the desired value. For example:

+12.00 V (+11.85 to +12.15 V)

In general, all checks, adjustments, and alignments require a statement of tolerances. Tolerances shall be expressed in the style that agrees with the use to be made of the information.

<u>USE</u>	<u>STYLE</u>	<u>Example: EXAMPLES</u>
Checking	Upper and Lower tolerance limits	Between 25 and 31 Vdc 12-15 psi
Adjusting	Optimum value, and upper (+) and lower (-) values	28 (25 to 29) Vdc 0.10 (0.09 to 0.11) in.

Tolerance values shall be given in terms of acceptable wear limits rather than nominal optimum values (if these values differ). For torque measurement, values shall be used that conform to the calibration of the tool being used (ft-lb, in-lb, etc.).

3.2.3 General style requirements for graphics. This section presents general style requirements relating to graphics or to associations of both graphics and text. Requirements as to the quality and level of detail of the graphics shall apply to the least capable device (i.e., smallest screen) on which the IETM is to be displayed as specified in the contract or specifically specified for use with the weapon system to be supported.

3.2.3.1 Measurements and tolerances. Measurements and tolerances shall be expressed in the same manner as required for text in Sections 2.2.2.9. and 2.2.2.10.

3.2.3.2 Types of illustrations. Where required, an IETM shall contain illustrations of such types as frontispiece (assembled view), isometric, perspective, orthogonal, phantom, etc. Line drawings shall be used rather than photographs to ensure quality and legibility of the illustrations. Half-tone and gray-scale illustrations shall not be used. All drawings shall be monochrome unless the contract specifically requires multiple colors.

3.2.3.2.1 Engineering drawings. Engineering drawings shall be acceptable as illustrations if they meet the content, style, and format requirements of this specification. Unnecessary data which reduce the comprehensibility and clarity of the illustration shall be removed.

3.2.3.2.2 Schematics and diagrams. Electrical and engineering diagrams shall be laid out functionally and shall be in accordance with the requirements of DOD-STD-100. Where information must be presented by means of a signal-flow chart or circuit diagram, such visual aids shall be divided into discrete units, simplified, and standardized to the greatest extent possible to adapt to the limitations of an EDS.

3.2.3.2.2.1 Schematic and wiring diagrams. Where possible, schematic and wiring diagrams shall contain only the information referenced by the text with which they are displayed.

3.2.3.2.2.2 Functional flow diagrams. Functional flow diagrams shall be drawn as flowcharts indicating the direction of system interaction. If possible, the diagrams shall contain only the detail referenced by the accompanying text.

3.2.3.3 Illustration conventions. Illustrations shall be displayed statically or interactively. Static illustrations shall require no manipulation to be viewed in full detail. Interactive illustrations shall allow the user to manipulate the illustration to better understand the illustration.

3.2.3.3.1 Static illustration display. Illustrations shall be displayed in full detail in the graphic area provided, with no need for manipulation. These illustrations may have associated callouts that can be displayed to indicate specific components of the illustration. Illustrations may be developed in a hierarchy where each layer depicts a portion of the system-subsystem hierarchy.

3.2.3.3.2 Interactive illustration display. After displaying an interactive illustration, the IETM shall provide the user with functions for manipulating the illustration. Interactive illustrations fall into the following categories:

3.2.3.3.2.1 Illustration with "Hot Spots". Illustrations may be displayed with specific areas that are sensitive to selection by a locator device. All such selectable options shall be displayed, each with a defined selection area present. When the cursor is moved inside the area and the selection mechanism for the cursor activated, the function represented by the option shall be executed.

3.2.3.3.2.2 Animated illustrations. If displaying an animated illustration, the animation sequence shall automatically begin after the entire screen has been displayed. The EDS shall allow the user to pause, repeat, and exit the animation sequence.

3.2.3.3.2.3 Realtime video images. When displaying a realtime video sequence, the video sequence shall automatically begin after the entire screen has been displayed. The IETM shall provide the user with the functions for pausing, repeating and exiting the video sequence.

3.2.3.3.3 Scale. Illustrations shall be prepared to a scale that ensures that all essential detail is legible.

3.2.3.3.4 Illustration density. Illustrations shall be displayed in the assigned area of the EDS display screen. An illustration shall typically be displayed in its entirety and in full detail. Illustrations requiring manipulation (such as pan and zoom) shall be displayed using interactive graphic display techniques described in this specification.

3.2.3.3.5 Highlighting illustrations for selection. Illustrations which have active selection portions shall display highlighted areas and the entire highlighted area shall be sensitive to selection using a locator device. The options may be displayed with variable-sized options and/or placement of options. All selectable options shall be displayed on the screen, each within an area highlighted using subtle color or gray-scale shading to highlight the "hot spot" without adversely affecting the appearance of the graphic.

3.2.3.4 Quality of illustrations. Illustrations shall be prepared to a scale that ensures that all essential detail is legible. Line widths shall be of sufficient density to register sharply and clearly on the EDS. The same line width shall be used throughout the IETM to maintain consistency. On an illustration containing any feature referred to by the text (e.g., screw head, contact, hole), the feature shall be shown at least as large as the smallest type used in the text of the document, and shall be clearly recognizable. No shading, stippling, or scratching shall be used. Font size shall be consistent within each illustration. Alphanumeric symbols accompanying a graphic shall be displayed using a sans serif font, and shall be displayed horizontally with no rotation. Alphanumeric lettering that is an inherent part of the graphic, such as labels on a panel, shall be displayed using font, size, and rotation as it appears on the actual item.

3.2.3.5 Level of detail in illustrations. The illustration shall present only the equipment items to which the action statements refer, plus sufficient surroundings to permit swift localization of the pertinent equipment item or part. Detail that serves only to give a photographic representation is neither necessary or desirable, but enough information shall be included to allow the user to locate and isolate the hardware item without error. For example, in locating a particular gauge on a large panel, the markings of each gauge need not be included, but the outline of every component on the panel shall be included. If all illustrations required to support an increment of text will not fit on the EDS, the text shall be put in two or more screens, each with its supporting illustration. Illustrations may be sequenced as necessary to support multi-screen tasks. The level of detail shall be deemed proper if the validator can easily find the required parts without error during validation. Similarly, the density of lines in the graphic shall be kept low enough to assure comprehensibility.

3.2.3.6 Textual citations of panel nomenclature. In all references to controls, control positions, test points, and indicating devices, which have panel or chassis nomenclature, the nomenclature used in the textual statement shall be displayed exactly as it appears on the panel or chassis (e.g., all capitals if used, spacing, and special symbols). Nomenclature shall not be enclosed in quotation marks unless required for clarity. If correction or clarification of spelling or of an abbreviation is considered necessary for comprehensibility, the availability of a "Comment" which the user may access shall be indicated.

Examples:

Set MASTER switch to OFF.
Turn EL SCAN control to NOR.
Set OPER switch to SP.
Set TEST switch S1801 (3) to position A.
Adjust SIG XTAL CUR ADJ for 3 ma on XTAL CUR meter M1.

In procedures involving controls and indicators with panel nomenclature, these items shall be identified only by the placarding on the panel. Circuit reference designators (R105, C56, etc.) shall be omitted unless the reference designator itself appears on the panel. If a control/indicator is unmarked on the panel, reference to a circuit reference designator may be necessary. If variations of panel or chassis nomenclature exist, a note explaining that the panel names are typical and may vary slightly from one unit to another shall be included.

3.2.3.6.1 Multiple controls/indicators with same panel nomenclature. If two or more controls/indicators have identical panel nomenclature, the circuit-reference designator shall be used unless an illustration reference is provided.

Examples:

Set OPR CONTROL switch S45 (2) to ADD.
Set OPR CONTROL switch S54 (3) to REM.
Set OPR CONTROL switch S76 (6) to ADD.
Set OPR CONTROL switch (8) to REM.

3.2.3.6.2 Controls/indicators without panel nomenclature. In procedures involving controls and indicators with functional names only (no panel names), these items shall be identified both by functional name (lower case letters) and by locator-illustration number.

Examples:

Adjust horizontal centering control (6).
INDICATION: Sweep trace centers on screen (7).

Set Attenuator switch S23

INDICATION: 8 dbm on DBM meter M16.

3.2.3.7 Angle of view. Illustrations shall be drawn from the same general angle of view that the equipment presents to the user (for example, during a given step of a procedure). Cutaways and hidden lines shall be used as required in conjunction with details that are accessible but not visible to the user (i.e., as seen after removal of an access cover or after opening a cabinet door), and these views also shall be drawn from the user's orientation. In situations where the user may view the hardware from more than one angle, the view which provides the most pertinent and necessary information in the simplest fashion shall be used. An item or part removed from the system may be rotated to show important features; but the axis, direction, and degrees of rotation shall be indicated in the illustration. Perspective and isometric drawings shall be used for a more realistic view as opposed to orthographic projection, unless the view is head-on.

3.2.3.8 Use of the human figure. When it is necessary to illustrate an operation or procedure, illustrations may include a human figure or parts of the body. Jewelry shall not appear in any illustrations. The human figure shall not be permitted to obscure details of the equipment necessary for a complete understanding of its operation. The human figure shall be clothed as designated by the acquiring activity. A cross section of races and sexes shall be used.

3.2.3.9 Oversize illustrations. If all illustrations required to support a unit of text cannot be displayed on a single screen presentation, the illustration relevant to the current text shall be presented. Illustrations shall be sequenced as necessary to support tasks which require multiple windows. The level of detail shall allow the user to easily find the required parts without error. Line density shall be kept low enough to assure comprehensibility.

3.2.4 General style requirements for audio information. Audio information may consist of non-verbal, auditory signals or tones, or computer generated speech. Whenever, audio output is utilized, it shall always be accompanied by redundant, non-audio information in such a manner that the information presentation is effective with the audio output device turned off.

3.2.4.1 Style requirements for non-verbal audio information. The use of non-verbal auditory signals or tones shall be limited to applications where its immediate discrimination is not critical to personnel safety or system performance. The frequency of non-verbal signals or tones shall be within the range of 200 to 5000 Hz, and preferable between 500 and 3000 Hz. A non-verbal audio signal or tone shall be of sufficiently low intensity and duration so as not to startle listeners, add to overall noise levels, or interfere with local speech activity. A non-

verbal signal or tone shall be similar to those commonly encountered in computer applications or usage.

3.2.4.1.1 Audio signals in conjunction with alerts. A single, non-verbal auditory signal or tone shall be used in conjunction with all visually displayed error messages and alerts. It shall precede the presentation of the visually displayed message or alert by no more than 0.5 seconds, and shall terminate upon complete presentation of the message or alert on the display.

3.2.4.1.2 Compatibility with ambient conditions. A non-verbal auditory signal or tone shall be compatible with the ambient conditions in which it is used. That is, if a particular signal or tone is commonly used in other work contexts, a similar signal or tone shall not be used by the presentation system.

3.2.4.2 Style requirements for computer-generated speech audio information. The use of computer-generated speech shall be limited to the presentation of procedural information. The rate of computer-generated speech presentations shall average between 125-175 words per minute. Computer-generated speech presentations shall be distinctive, mature, articulate and well-modulated; approximately the quality of professional broadcast announcers.

3.2.4.2.1 Pronunciation of abbreviations. The computer-generated speech presentation system shall be conditioned to recognize and pronounce any abbreviation used in the context of procedural information into its "whole word" equivalent (e.g., the abbreviation "sec." shall be pronounced "second"). Alternatively, an abbreviations may be presented as single letters if that is the common method of reading the abbreviation aloud (e.g., the abbreviation "rpm" shall be pronounced: "r-p-m").

3.2.4.2.2 Pronunciation of acronyms. Any acronym used in the context of procedural information that either cannot be or typically, is not pronounced as a whole recognizable word, shall be presented by the computer-generated speech presentation system as single letters (e.g., the acronym "APU" shall be pronounced: "A-P-U").

3.2.4.2.3 Pronunciation of alphanumeric strings. Any strings of digits or alphanumeric characters used in the context of procedural information that typically are not pronounced as an intact unit shall be presented by the computer-generated speech system as single letters or combinations of number and letters (e.g., the reference designator A1A12A9 shall be pronounced: "A(one)-A(twelve)-A(nine); while the part number 78349015 shall be pronounced: "7-8-3-4-9-0-1-5").

3.2.5 General style requirements for video information. Video information may consist of video (motion picture) information or animated information.

3.2.5.1 Style requirements for video information. Video information shall follow the requirements for illustrative information given above. Any specific person shown performing tasks shall appear throughout the entire set of steps or actions which comprise the task. Persons appearing in video information shall not obscure details of the equipment or item being worked on so as to prevent a complete understanding of how to perform or complete the operation or procedure.

3.2.5.2 Style requirements for animated information. The display motion of animated information shall be of sufficient magnitude to be easily detected and recognized by the user. If the user is required to discern fine detail on an item or process, the rate of motion shall not exceed 60 degrees per second of visual angle change, with 20 degrees per second preferred. The user shall be able to clearly differentiate the animated item or process from the background and other static information on the display.

3.3 General display formatting and user interaction. This section defines the general formatting and user-interaction requirements of a common user interface for presenting technical manual information on an EDS. It is the intent of this specification that all functions required in this section (3.3) can be easily implemented in a readily available commercial graphic user interface or windowing software package. The specific user interface requirements peculiar to IETMs shall be limited to the client area and are described in Section 3.4.

NOTE TO REVIEWERS OF THE DRAFT SPECIFICATION:
The detail of this section is intended to describe an user interface that can be implemented in both MOTIF and Open Look as the leading user interfaces for **IX machines. At such time as many of the details in this specification are commonly accepted as a commercial standard much of the detail could be eliminated in favor of citing the standard.

3.3.1 EDS requirements. All EDSS used to present IETMs shall provide the display formatting and user-interaction functions described herein. The required user interaction functions (e.g., SELECT, CANCEL, ENTER, DELETE...) are written in all caps throughout this specification. These functions are not meant to be literal key names on the device, but logical or "virtual" functions which must be implemented in some way by

the display device. For example, the cursor movement and selection functions (i.e., UP, DOWN, LEFT, RIGHT, SELECT, CANCEL) may be implemented by a mouse, a joystick, a track ball, a light pen, a touch panel, or a set of arrow keys with a selection key. An ENTER function may be implemented as a dedicated key or a "soft" function key. In this way, this specification identifies the logical user input functions which shall be supported by the display system, without specifying the exact keyboard or hardware requirements for the display system.

3.3.2 Common user interface components. A common set of user interface components and presentation conventions shall be used to provide a consistent interface across all presentation devices. These user interface components and presentation conventions are common to most graphical user interfaces. The common interface components described in this specification shall be implemented on all of the various types of presentation systems from a large screen device to a portable small screen device. The requirements specified herein shall apply to all types of devices unless specifically noted. The components described are as follows: windows, menus, controls, and dialogs.

3.3.2.1 Cursor movement and selection. The system shall provide the user with the ability to select displayed information on the screen. The user shall have the capability to SELECT a single object, a range of objects, and additional (non-contiguous) objects including multiple ranges. This capability will be used for at least the following purposes:

- a. to select an individual word, such as a system name, displayed in a text paragraph.
- b. to select an item displayed in a list or menu.
- c. to select an individual graphic object, such as a part, displayed in a graphic illustration.
- d. to select a point or rectangular area in a graphic image.
- e. to select an individual cell displayed in a table.

3.3.2.1.1 Cursor selection. To make a selection the user shall always use the same basic steps: 1) place the cursor on the display object to select; 2) use a SELECT function to activate the selection. The information selected shall be highlighted to provide the user with visual feedback of the selection. The user shall be able to CANCEL a selection operation by activating the CANCEL function before the operation is complete. Implementing the CANCEL function shall undo the last selection.

3.3.2.1.2 Cursor movement. Selecting items on the display screen shall require a cursor capability and the capability to move or position the cursor on the screen. If the system does not provide a free-form

positioning device, such as a mouse, it shall provide, as a minimum, the capability to move the cursor up, down, left, and right. The functions UP, DOWN, LEFT, and RIGHT, shall enable the user to move the cursor in the direction indicated. The nature of the movement shall depend on the cursor movement mode in effect at the time. The cursor shall have the capability to move in at least two different modes, which shall be available to the user.

3.3.2.1.2.1 Pixel movement mode. In this mode the user shall be able to move the cursor one pixel at a time. The cursor movement device shall enable the user to make detailed relocations of the cursor. This pixel movement mode shall be the default movement mode. The cursor shall normally function in this way. The number of pixels moved may vary with the resolution of the presentation device and may be selectable by the user.

3.3.2.1.2.2 Selectable-only movement mode. This mode shall enable the user to move the cursor from one selectable piece of information to another such as; cell to cell (in a table), from selectable word to selectable word (in text), from selectable object to selectable object (in a graphic). This selectable movement shall also be used when filling in dialogs with the computer (See Section 2.3.2.4.). The cursor in this case shall move only to items which require input from the user. Selectable information shall be distinguished from other information on the screen by the use of a border or frame around the selectable object and by the use of highlighting when in the selectable-only movement mode. When this movement mode is not invoked specifically, the cursor movement mode shall automatically default to the pixel movement mode.

3.3.2.1.3 Cursor shapes. Different cursor shapes shall be used to designate different interactive modes. For example, the leaping cursor to indicate selectable-only movement may be a frog. The text insertion shall be a blinking vertical line. The pointer or location cursor shall be an arrow.

3.3.2.2 Windows. A window shall be an area of the screen that displays information and provides the user with the functional means to communicate with the underlying application software program. The presentation system shall have the capability to display a minimum of three windows on the screen at one time, but only one window will be active at any one time. Window activity shall be driven by where the cursor is located at the moment. An active window shall be designated by a highlighted title bar. The system shall provide the capability to OPEN and CLOSE windows. The windows shall be capable of overlapping, tiling, re-stacking, and iconifying (i.e. collapsing into an icon). IETM applications specified for a small screen device may restrict the use of multiple windows, in which case all of the screen acts as if it is one window.

3.3.2.2.1 Window presentation. Windows shall be presented with the layout as shown in Figure 1. Although the window layout is standard,

specific components of the window may not be required for an application and may be excluded. For example, if changing the size of the window is not required then the resize border should not be included as one of the window components. The client area and title bar shall be mandatory for all applications. Unless otherwise specified, a window shall be composed of a client area, a title bar, a resize border, a window menu button, and window control buttons.

Figure 1. Standard Window Layout and Typical Window Components for a Large Screen Display Device.

3.3.2.2.1.1 Client area. The client area shall be the portion of the window in which the user will perform most application-level tasks. The client area shall be inside the window frame and can be composed of multiple "panes" or viewports holding a mixture of text, tables, graphics, etc. The IETM contents shall be displayed in the client area as specified in Section 3.4.

3.3.2.2.1.2 Title bar. The title area shall be the horizontal bar that lies at the top of the window. The title area shall be the top portion of the window frame. The title bar shall be highlighted when the window is active. The title bar shall contain the title of the information being displayed. The title shall be a succinct description of the displayed information, consisting of a verb describing the action and a noun describing the object of the action. The title shall be displayed in all uppercase characters. For example: "REMOVAL OF FIRE CONTROL RADAR." The date and time shall be displayed, right-justified, on the title bar. The date shall be in Julian format and the time shall be local time, displayed in 24-hour format.

(AF) 3.3.2.2.1.2.1 Small device title bar. Display software specifically developed for a small device may have a title bar which toggles on and off with a menu bar. The menu bar shall appear only at the user's request. The title bar shall be the default information at the top of the window of the small screen device.

3.3.2.2.1.2.2 Requirement for a title bar. There shall be a title bar at the top of every window unless overlayed by the toggleable menu bar allowed for a small screen device.

3.3.2.2.1.3 Message area. The message area shall be an area at the bottom of the display device screen in which system messages are located. System messages shall normally be warnings or cautions pertaining to the computer system and software. System messages shall occur in this same area of the screen whenever such a message is displayed.

3.3.2.2.1.4 Resize border. Each application shall suggest the initial size of its windows to the window manager. Window sizes may vary

according to the work the user will perform in them. If this resize capability is an option, at any time the user shall be able to alter the size of the active window. The control mechanism for resize function shall be located inside the window frame on one of the corners of the frame. Windows which are resizable shall have a distinctive border which signifies that it can be resized. The capability to resize windows is not a specific requirement for the portable small-screen device.

3.3.2.2.1.5 Window menu button. The window menu button shall be located on the title bar in the leftmost corner and shall be used to activate a window menu. The window menu which may also be referred to as the system menu, shall provide a standard location for window management functions.

3.3.2.2.1.6 Window control buttons. Window control buttons shall be push buttons in the rightmost corner of the title area and shall be used for frequently used window management functions such as MAXIMIZE and MINIMIZE. The MAXIMIZE and shall allow the user to enlarge an open window to its maximum size. The MINIMIZE function shall allow the user to shrink the window to the minimum size available. The capability to change the size of a window is not a requirement for the small screen device.

3.3.2.2.2 Window manipulation (scroll bars). Whenever the information to be displayed is larger than the available window area, the user shall be able to manipulate the displayed image by scrolling the information image to view its entire contents. The need for this capability shall be minimized as much as possible. Whenever possible, information shall be displayed so that no scrolling or other display manipulations are required. Vertical and horizontal scroll bars shall be used to provide the user with the capability to SCROLL-UP, SCROLL-DOWN, SCROLL-LEFT, SCROLL-RIGHT the displayed information (text, graphic, table, etc.). Scroll bars shall appear at the bottom of the window (the window frame) above the footer bar and at the right edge of the window with arrow marks at each corner. Scroll bars shall have the following components; a scroll region which is the background of the scroll bar and represents visually the length of the area that the user can scroll; a slider which represents the window through which the user looks at the displayed data; and stepper arrows which enable the user to scroll incrementally through the data. When the user uses a scroll bar to view information, the information shall appear to move in the direction opposite to the movement of the slider. For example, in a text window, if the slider of a vertical scroll bar moves up, a text display seems to move down as previous lines in the information appear at the top of the window.

Figure 2. Window with Scroll Bars.

3.3.2.3 Menu system. The user shall be able to access all of the functions available on the system through a menu system which consists of a menu bar (hierarchy of pull-down menus) and a set of pop-up menus.

3.3.2.3.1 Pull-down menus. Pull-down menus shall be displayed as a vertical column of selectable items. The most commonly used pull-down menu is the menu bar. Titles on the menu bar of available pull-down menus shall always be visible to the user, so that the user is not forced to remember the available functions.

3.3.2.3.2 Pop-up menus. Pop-up menus shall be displayed as vertical columns of selectable information. Pop-up menus shall appear at the current cursor location (provided that the cursor location has a menu associated with it).

3.3.2.3.3 Cascading menus. Cascading menus or submenus shall be used to add detail to pull-down and pop-up menus. Cascading menus provide a tree-like structure for organizing information, thus simplifying the presentation of complex lists. A cascading menu shall appear when the user moves the cursor to the right of the title on a parent menu. A right arrow following the menu option is used to designate a cascading menu. If the user moves the cursor to the left while the submenu is displayed, the submenu shall disappear, and the parent menu shall be restored to its original appearance and functionality. If the user activates the SELECT function while in the submenu, the highlighted option shall be selected. To maintain ease of use, the menu selection tree shall not be more than three levels deep.

3.3.2.3.4 Menu presentation details. Menus shall be short-lived. Menus shall appear quickly and exist only while a selection is being chosen. Menus shall be modal, i.e., the user shall not be able to interact with any other part of the data until the menu is removed. To use a menu the user shall position the cursor on the menu selection and use the SELECT function to activate the action. The user shall be allowed to exit any menu by activating the CANCEL function.

3.3.2.3.4.1 Menu dimensions. The size of the menu shall be determined dynamically by the number of options supported.

3.3.2.3.4.2 Menu width. The minimum menu column width shall be no less than 5 text characters. Menu columns shall be wide enough to enclose all menu item labels or options so that no option is truncated.

3.3.2.3.4.3 Menu height. Each menu item shall be the height of one text line. The minimum menu height shall be the height of two text lines. The maximum menu height shall be the height of the screen. Line spacing for menu items shall conform to the requirements for the display and selection of text (see Section 3.3.3.1.2).

3.3.2.3.4.4 Menu border. The menu shall be drawn with a boundary extending beyond the menu cells in order to distinguish the menu from the remainder of the screen.

3.3.2.3.4.5 Highlighting. Highlighting shall be used to provide feedback to the user whenever a menu option is initiated by the cursor. That is, reverse-video (or similar brightness coding) shall be used to highlight the menu item currently indicated by the cursor position.

3.3.2.3.4.6 De-emphasis. The system shall de-emphasize functions which are unavailable in the present context by using a gray out or dimming method. This will provide the user with an immediate visual cue. In cases where all of the menu selections of a specific menu are disabled the user shall be able to display the menu.

3.3.2.3.4.7 Organization of selections. The selections on the menus shall be organized into logical groups. Destructive commands shall not be displayed next to frequently chosen selections. The menu selections shall be ordered by frequency of use by positioning the most frequently used functions at the top.

3.3.2.3.4.8 Cursor default locations. The cursor shall have a default location for all menus. This default location shall be based on the most frequently selected option.

3.3.2.3.4.9 Menu colors. Menus shall be drawn with a background that is easily discernable from the screen on which it is displayed. If a color display device is used, the colors for menus shall be selected from a set of pre-defined presentation system color combinations.

3.3.2.3.5 Menu bar. A single, row-wise, menu bar shall appear at the top of every window, for a large screen device, and at the top of the display screen when activated on a small screen device. The number of menu titles listed on the menu bar shall be limited to eight. Each title on the menu bar shall be given a one-word descriptive label that clearly differentiates that menu from other menus in the menu bar as well as from option column-wise menu lists defined below. All of the functions available on the system shall be listed in menus on the menu bar and shall be accessible by the user at any time. Selecting a choice from the menu bar shall activate a pull-down menu from that choice. The titles of available pull-down menus on the system shall be listed in the menu bar, making the functionality of the system available by simply pointing and selecting. The system shall enable the user to move the cursor across the titles in the menu bar and view all of the available functions. The following menu titles are recommended as the standard menu titles in the menu bar: File, Edit, and Help. Other possible menu titles are View and Options.

3.3.2.3.5.1 Menu bar on small screen device. On a small screen device the title bar and the menu bar shall be located in the same area with the ability that each be toggled on and off through a MENU function.

The default information in the top area of the window shall be the title bar. When the menu bar is displayed, the title bar shall disappear and vice versa. The user shall be able to view either the title bar or the menu bar at all times.

3.3.2.3.5.2 Menu bar on large screen device. On large screen devices, the title bar and menu bar shall both be visible at the top of each window. The title bar shall appear at the top of the window with the menu bar directly below the title bar.

3.3.2.3.6 Menu bypass. The system shall provide the user with shortcuts for making selections from menus other than using the navigation and selection functions. This shall be done by using mnemonics or numeric entries. Users may enter the required numeric key value(s) or mnemonic key combination that corresponds to displayed menu options which shall activate the menu avoidance/menu by-pass function. Mnemonics and numeric values shall be designed for menu entries that the user activates frequently. Some type of feedback (auditory signal or a system message in the message area) shall be provided to the user to indicate when the menu bypass is not active.

3.3.2.3.6.1 Mnemonic. A mnemonic shall be a single character usually the first letter of the selection. For example, "S" may be the mnemonic for the SELECT function. The mnemonic for the various menus shall be underlined to provide a visual cue to the user. If two selections in a menu begin with the same letter then some sort of mnemonic for the selection should be used. If the mnemonic of the selection does not appear in the text then it shall be included in parentheses after the text. Mnemonics shall only be available when the menu containing them is displayed. If mnemonics are used, the mnemonics for the selections from the menu bar shall be used at all times on the large screen device, and only when the menu bar is displayed on the small screen device.

3.3.2.3.6.2 Numeric values. Numeric values may be used as an option to mnemonics as the shortcut for accessing functions from a menu without actually moving the cursor and making a selection. For example the user would like to go to the first menu (1. File) and access the open file function (3. Open), so the user types "13 SELECT". The SELECT function finalizes the selection sequence. If this menu bypass method is implemented than no more than nine functions shall be available from any one menu. A DELETE function shall be provided to allow the user to make changes to alphanumeric entries. The DELETE function shall work like the rub-out key on most computers, deleting the character immediately to the left of the cursor. If numeric values are used, the numeric entries for selections from the menu bar shall be used at all times on the large screen device and when the menu bar is displayed on the small screen device.

3.3.2.3.6.2.1 Selection numbers. Selection numbers for menu bar titles and corresponding functions in each menu list shall be separated from their text descriptors by at least one blank space. The numeric code

and descriptive label for each choice on the menu shall be left justified relative to the boundaries of their respective column-wise menu lists. The number 0 shall always be used to exit or quit the current menu. The exit option shall always appear as the last option on each menu.

3.3.2.3.7 Menu bar titles and contents. The menu bar has five recommended titles: File, Edit, View, Options, and Help. The File and Edit menus have recommended contents that are described in sections 2.3.2.3.7.1 and 2.3.2.3.7.2, respectively. The File and Edit menus should be the first two titles in the menu bar and the Help menu shall always be the last. The View and Options menus are highly specific to the application and do not have standard selections. Although they are recommended titles for the menu bar actual titles will depend on the nature of the application. If more relevant titles and selections are required for an application's menu bar and menus, the meanings of the words (File, Edit, Help) used in the standard menus shall not be changed.

3.3.2.3.7.1 File menu. The file menu (figure 3) shall present actions that deal with files in their entirety. All applications that deal with files should provide a File menu. The selections in the menu are grouped as follows:

- a. selecting files that connect a file to an application.
- b. saving actions that transfer changes made to a storage medium.
- c. output actions that send the changed file to an output device.
- d. other actions.

Figure 3. Menu Bar with "pull-down" File menu for Small Screen Device.

3.3.2.3.7.1.1 File menu contents. The File menu shall contain the following selections:

- a. NEW. Creates a new file in a window.
- b. OPEN. Opens a window on an existing file.
- c. SAVE AS... Saves the currently opened file under a new name.
- d. PRINT. Schedules a file for printing.
- e. EXIT (QUIT). Exit or quit on some applications ends the current application and closes all windows associated with it. The user shall have the option to save the current state including current

location within the database, current context, the current state of any diagnostic procedures, etc. for later resumption of the program.

3.3.2.3.7.2 Edit menu. The Edit menu shall contain actions that modify the contents of the data which the application is currently dealing. Many of the actions relate to cut and paste functionality. The standard selections are grouped as follows:

- a. Undo actions that reserve the effect of the user's actions.
- b. Actions that relate to system-wide clipboard.
- c. Actions that do not relate to the clipboard.

3.3.2.3.7.2.1 Edit menu contents. The Edit menu shall contain the following selections:

- a. UNDO. Reverses the most recently executed action.
- b. CUT. Removes a selected portion of data from the client area to the "clipboard" buffer.
- c. COPY. Copies a selected portion of data to the clipboard without removing the original data from the client area.
- d. PASTE. Pastes the contents of the clipboard into a client area at the selected location.

3.3.2.3.7.3 Help menu. The system shall provide a Help menu for the user to use if required. The Help menu can contain the following selections:

- a. On Context. Provides context-sensitive help about the specific situation that exists or the information being displayed on the system when the help was requested.
- b. On Help. Provides information on how to use the application's help facility.
- c. On Window. Provides general information about the operation of the window from which the help was requested.
- d. On Keys. Provides information about the function keys and keyboard accelerator.
- e. On System. Help related to use of the computer system being used to view the IETM.
- f. Index. Provides an index with a search capability for all help information.

g. Tutorial. Provides access to the application's tutorial if it exists.

3.3.2.3.7.3.1 Help menu contents. The Help menu shall contain the following selections:

b. CONTEXT-SENSITIVE. Help related to the information being displayed on the system when this function is accessed.

3.3.2.4 Dialogs and controls. A dialog box shall be a window that contains graphical controls (buttons) which the user shall use to converse with the underlying application software. There are four kinds of dialogs. Alerts, fill-in-the-blanks, selection choices, and multiple dialogs. Dialog boxes shall appear in a consistent and prominent location on the display. The layout and arrangement of all dialogs and forms shall allow the user to differentiate between the material they contain and other types of displayed information.

3.3.2.4.1 Dialog presentation. Headings used in dialog boxes shall be distinctive such that they cannot be confused with response alternatives, labeled control options, guidance messages or other displayed material. Headings used in dialog boxes shall be placed in close proximity to their respective response alternatives; ending with a special symbol (e.g., a colon), to signify that a response alternative may be selected after that point.

3.3.2.4.2 Dialog controls (buttons). Dialog boxes shall contain graphical controls called buttons. A button shall be a selectable word or graphic icon on the screen which enables the user to make a selection or initiate an action. A common button is the push button. Push buttons shall be found on every type of dialog. Push buttons shall be single action entities. They may invoke a general action like CANCEL or ENTER (see Figure 4). They shall appear as a geometrical shape with the name of the selection written inside of the shape. All buttons shall be large enough for the user's cursor to fit inside. Buttons or choices may be highlighted by use of reverse video to "flash" when a user selects that button in a dialog box.

Figure 4. Example of Push Buttons.

3.3.2.4.2.1 Usage of push buttons. When the user is presented with a dialog box, the user shall complete the dialog or acknowledge its presence. In order to complete the dialog box, the user shall select all buttons he chooses to use. This shall be done by moving the cursor into the button and activating the SELECT function. After selecting the preferred options, the user will have at least three push buttons located in the bottom of the box. As a minimum, the three buttons shall have the following functions "OK", "CANCEL" and "HELP". "CANCEL" shall

be equivalent to the CANCEL function, and "HELP" shall be equivalent to the underlying application software HELP function. Through the use of these common dialog buttons the user's intentions may be communicated by positioning the cursor on the button and activating the SELECT function. This selection action shall communicate to the application software that the user has completed filling all buttons. The CANCEL function may be used to deselect the choices made with the SELECT function. To change a finalized dialog box after the "OK" function has been activated, the user shall reactivate the dialog box and make changes.

3.3.2.4.2.2 Button presentation. Common push buttons ("OK", "CANCEL", and "HELP") shall be displayed along the bottom of the dialog box. The common dialog buttons shall correspond to a completion of action, which is the last selection the user makes before leaving the dialog box. The buttons displayed in the dialog box shall be large enough so the user may position the cursor in the button they wish to select.

3.3.2.4.3 Alerts. Alerts shall be any message, communication, notice, or output which requires acknowledgement by the user. Alert messages shall be generated as a result of erroneous user inputs or sequence control actions. Alerts shall provide information regarding the processing status of user inputs and requests. They shall also provide information about the status of the system's internal components (e.g., low battery power, improper functioning of the operating system or memory module). Alerts may also include warnings or cautionary messages to the user about potentially destructive data/command entries before they are executed by the computer.

3.3.2.4.3.1 Alert information content. Alerts shall be brief, consistent, strictly factual and informative; written in the affirmative and preferably in the active voice. Alerts shall be constructed using neutral words that do not imply or ascribe blame to the user, "personalize" the computer, or attempt to make the content of the information humorous. Alerts regarding erroneous or potentially destructive external system(s) should be made available to the user. Following user interrupt of a data processing or a database navigation/sequencing command (e.g., CANCEL), an advisory message shall be displayed to assure the user that the system has returned to its previous status, unless it is otherwise obvious. Alerts shall be displayed after a user's data/command entry has been completed (i.e. nominally within 2-3 seconds) so as to initialize disruption of the user's thought process and task performance.

3.3.2.4.4 Selection choice. A selection choice shall represent a type of dialog in which a selection from a group of choices must be made. Selections shall be made from radio buttons and/or check buttons.

3.3.2.4.4.1 Radio buttons. Radio buttons shall be grouped into lists of mutually exclusive choices. They shall appear to be an empty circle and shall be filled with a dot when selected. (see Figure 5)

3.3.2.4.4.2 Check buttons. Check-buttons shall be grouped into lists of non-mutually exclusive choices. The user may check several of these buttons if needed. These buttons shall appear as an empty square and shall be filled with an "X" when selected. (see Figure 5)

Figure 5. Example of Radio and Check Buttons.

3.3.2.4.4.3 Selection choice presentation. Buttons shall be right justified and separated from text descriptors by at least one blank space. If there are so many choices in the box that the choices have to be placed in columns, the button position shall be right justified with respect to their columnwise position. (see Figure 6) Each response alternative listed in a dialog box shall be given a short descriptive label of 1 to 5 words (including acronyms, abbreviations, special characters and symbols, etc.) that clearly differentiates it from the other alternatives. When buttons are used and more than one choice is available for selection, the presentation system shall place the cursor automatically at the beginning of the first data entry item, then display the list of plausible alternatives. Once a particular alternative has been selected in response to the first data entry, the user shall be required to take an explicit action to move the cursor to the next response alternative. The number of responses listed for any one dialogue box shall be limited to a discrete number of plausible alternatives; preferably in the range of 10-12 maximum.

Figure 6. Example of a Selection Choice.

3.3.2.4.5 Fill-in-the-blank. This shall be a dialog that provides essentially "free-form" input of alphanumeric characters in response to displayed questions and/or data entry fields (e.g., inputting user identification data when "signing-on" to the computer system; entering the title and/or number of database frames that contain errors or discrepancies, etc.). Responses to items contained in dialog boxes and forms may default to the fill-in-the-blank mode of data entry. See figure 7 for an example of a fill-in-the-blank.

Figure 7. Example Fill-in-the-Blank.

3.3.2.4.5.1 Fill-in-the-blank layout. For all fill-in-the-blank type dialogs, data entries shall be prompted explicitly by displayed labels for data fields and/or by associated user guidance messages. Field labels shall consistently indicate what data items are to be entered, always employing the same label to indicate the same kind of data entry. The layout and arrangement of all fill-in-the-blank-type dialog shall

allow the user to differentiate between the material they contain and other types of displayed information.

3.3.2.4.5.2 Field labels. Labels for data fields shall be distinctive such that they cannot be confused with data entries, labeled control options, guidance messages or other displayed material. Field labels shall be placed in close proximity to their respective data entry area; ending with a special symbol (e.g., a colon), to signify that an entry may be made at that point. Field labels shall employ descriptive wording or standard, predefined terms, codes, and/or abbreviations. When a unit of measurement (e.g., volts, ohms, rpm, etc.) is consistently associated with a particular data field, it should be displayed as part of the fixed label rather than entered by the user. Implicit prompting by field delineation (e.g., a broken-line underscore) shall be used to indicate a fixed or maximum acceptable length of responses to fill-in-the-blank type items.

3.3.2.4.5.3 Data entry fields. When a fill-in-the-blank-type item is shown on the screen, the text entry cursor shall be automatically placed where the user must provide an answer. The user shall use the ENTER function to signal to the computer that the dialog box, which may contain one or more fill-in-the-blank type actions, has been completed. The user shall be able to DELETE, CANCEL, otherwise change responses before activating the ENTER function.

3.3.2.4.5.4 Data entry. Depending on the type and purpose of the delivery device, there may be many different types of keyboards implemented for user interaction. The keyboard for the large screen in-shop device may be a full QWERTY keyboard with a mouse or other cursor movement device. The small screen device may have a very limited number of keys (numeric keys, no alpha characters, and no mouse). Data entry on the large screen device may be through the use of the QWERTY keyboard and the mouse, but on the portable device an alphanumeric matrix shall be used for data entry. The 4 X 7 alphanumeric matrix shall appear as a dialog box when the user is required to make a text entry. To use the alphanumeric matrix the user shall position the cursor on the letter to be selected, and activate the SELECT function to choose that letter. To indicate that an alphanumeric entry is complete, the user shall activate the CLOSE function. The CLOSE function shall close the dialog box that contains the alphanumeric matrix and move the text entry cursor to the next fill-in-the-blank type action. The user shall have the capability to change entries by activating the DELETE function. The DELETE function shall erase the character immediately to the left of the cursor. The DELETE function shall be a repeating function. In other words, if the DELETE function is mapped to a dedicated key, when the user holds down this key the delete function will be repeated.

3.3.2.4.6 Multiple dialog (forms). Multiple dialogs represent a type of form for the user to complete. A combination of the previous types of dialogs may be located together, requiring the user to complete the form before ENTERing the form into the computer. (see Figure 8)

Figure 8. Example Multiple Dialog Box.

3.3.3 Display formatting and user interaction requirements for primitive data regions. This section describes the primitive entities (text, graphics, tables, and user prompts) that may be displayed in the client area. The combination of the primitives entities into "screens" of technical information for the actual IETM to be displayed in the client area will be described in section 3.4 of this specification.

3.3.3.1 Text. Textual information shall consist of alphanumeric (character) data consisting of letters, words, sentences, paragraphs, numbers, etc. Text primitives may be combined to produce composite information that can be displayed, selected, and manipulated.

3.3.3.1.1 Display of text. Textual information shall be displayed in rectangular areas of the window client area. Text shall be displayed in uppercase and lowercase characters.

3.3.3.1.1.1 Character font. All fonts shall contain both uppercase and lowercase letters. The smallest character size will be no less than 7 X 9 pixels in size and 0.13 inches (.33 cm) in height, assuming a 3 foot viewing distance. The standard unit of measurement for text size is defined as the character height, with other dimensions referenced to height. Standard sizes are based on the viewing angle subtended at some given viewing distance. The following equation shall be used to determine the minimum character height.

$$\text{Angle in minutes of arc} = (\text{character ht.} \times \text{distance}) / (57.3 \times 60)$$

Based on a viewing distance of 36 inches with a recommended viewing angle of 12 minutes of arc, the preferred height of the characters in textual displays is calculated as:

$$(12\text{min} \times 36\text{in}) / (57.3 \times 60) = .13 \text{ inches}$$

Character height-to-weight ratio for characters in textual displays should be about 1:0:8. Table 1 lists the minimum character heights for

various viewing distances and shall be used to determine the appropriate character font size.

Viewing Distance (inches)	Minimum Character Height (inches)
18	0.06
24	0.08
30	0.10
36	0.13
42	0.15
48	0.17
54	0.19
60	0.21
66	0.23
72	0.25

TABLE 1. Minimum Character Heights for Various Viewing Distances.

3.3.3.1.1.2 Character spacing. Intercharacter spacing for characters in textual displays should be 0.1 character height.

3.3.3.1.1.3 Line dimensions. Between word spacing for textual displays should be one (nominal) character width. Between line spacing for textual displays should be 0.15 character height (minimum) exclusive of superscripts and subscripts.

3.3.3.1.1.3.1 Text on small screen. When presenting textual information on a small screen device, a minimum of 30 characters per line and no more than 60 characters per line shall be displayed.

3.3.3.1.1.4 Margins. Margins shall be required for all windows to prevent information from being obscured by borders or the information in adjacent windows. Margins for text panes shall be at least one space character wide on all sides.

3.3.3.1.1.5 Justification. Left justification shall be used for all lines of text displayed as sentences or paragraphs, leaving ragged right margins if that is the result. Titles should be centered and symmetrically balanced.

3.3.3.1.1.6 Word wrapping. The system shall provide the capability to wrap lines of text, so that no line will extend beyond the limits of the screen. If the text is resized, all of the text shall always be visible. If the resized version extends beyond the viewable screen, the system will wrap the lines of text so that no line extends past the right margin, and the user shall be given the option to scroll downward to view the rest of the paragraph or instruction.

3.3.3.1.1.7 Hyphenation. Hyphenation will be minimally used. It is better to have a jagged right edge than make a user read a hyphenated word.

3.3.3.1.2 Selection of text. The user shall be able to select a character string by positioning the cursor on or near that string and activating the SELECT function. This capability shall be used for at least the following purposes:

- a. to point to a highlighted text area to obtain a list of other database elements (e.g. text, graphics, tables, etc.) that are related to or are cross-referenced from the currently displayed textual information.
- b. to select a segment of reverse-video text for the purpose of obtaining definitions or additional information about the currently displayed textual information.

3.3.3.1.2.1 Highlighting text for selection. The system shall consistently highlight items of information on the screen. Highlighting techniques may include, but are not limited to; color, brightness, image reversal, and font.

3.3.3.1.2.1.1 Color. The number of colors used shall be less than or equal to four. The colors shall be selected to maximize differentiation. The use of colors shall be conservative in order to avoid an appearance of clutter.

3.3.3.1.2.1.2 Brightness. This technique involves the display of items at different luminance levels. The maximum number of levels of brightness coding shall be three, with two levels preferred. Maximum contrast shall be provided between an item and its background. The use of brightness shall be consistent. For example, high brightness levels may be used to signify information of primary importance and lower levels to signify information of secondary interest.

3.3.3.1.2.1.3 Image reversal. This technique shall be defined by the following example: if the normal display consists of light characters on a dark background, then image reversal of a specific item of information will be dark characters on a light background.

3.3.3.1.2.1.4 Font. This technique shall involve the use of different character fonts to highlight information. No more than three fonts shall be used. The choice of fonts shall maximize differentiation. The use of fonts shall be consistent. The use of fonts shall not compromise legibility.

3.3.3.1.3 Manipulation of text. While the need for scrolling and zooming of textual information shall be minimized, the user shall have the capability to manipulate displayed text by activating a SCROLL and/or ZOOM function. Scrolling of textual information is primarily

defined as moving vertically (up or down) through presented data to expose additional lines of text. Zooming is defined as a process of selectively enlarging or reducing the normal (default) character size of the displayed textual information.

3.3.3.1.3.1 Scrolling. The user shall have the capability to scroll textual information, one line at a time, through the use of the SCROLL-UP, SCROLL-DOWN, SCROLL-LEFT, and SCROLL-RIGHT functions. When text that exceeds the size of the screen, scroll bars shall appear to provide the user with a visual cue that the capability to scroll the displayed information exists.

3.3.3.1.3.2 Zooming. The system shall provide the capability to enlarge or reduce the displayed textual information. The text enlargement capability shall be provided to the user by activating a ZOOM-IN function. The user shall have the capability to enlarge any displayed textual information by as much as four times its normal size with no degradation of clarity. The center of the textual information to be enlarged shall be indicated by the placement of the position cursor. This capability shall make the textual information more legible when viewed from a greater-than-normal distance. The user shall have the capability to reduce the size of the textual information being displayed by activating a ZOOM-OUT function. This function shall be used to reduce the size of existing information or reduce the size of information that has been enlarged. Enlargement/reduction (zooming) should be provided separately for each window or half of a split screen.

3.3.3.2 Graphics. Graphics (drawings, illustrations) shall be hierarchical and object-oriented. Graphic primitives shall be combined to produce composite information which can be displayed, selected, and manipulated.

3.3.3.2.1 Display of graphics. The delivery device shall be able to display raster and vector graphics. Graphics may have associated callouts that shall be displayed with the graphic to indicate specific components of the graphic.

3.3.3.2.1.1 Scale. Illustrations shall be displayed to a scale that ensures that all essential detail is legible.

3.3.3.2.1.2 Graphic density. Graphics shall avoid unnecessary detail, unwanted graphic patterns, and unnecessary illusions. A graphic shall typically be displayed in its entirety with necessary detail. Graphics shall only show the detail that supports the action being described.

3.3.3.2.2 Selection of graphics. The user shall be able to select a point, area, or the entire graphic by positioning the cursor on or near that point and activating the SELECT function. The selection of graphical information includes but is not limited to the following:

a. selecting an individual graphic object, such as a part, displayed in a graphic illustration.

b. selecting a point or rectangular area in a graphic image.

3.3.3.2.2.1 Highlighting graphics for selection. Graphics which have active selection portions shall display highlighted areas which shall be sensitive to selection using the position cursor. The options may be displayed with variable sized options and/or placement options. All selectable options shall be displayed on the screen, each within an area highlighted using color (see 3.3.3.1.3.1.1) and subtle gray-scale shading to highlight the selectable area without adversely affecting the appearance of the graphic.

3.3.3.2.3 Manipulation of graphics. The user shall have the capability to activate a SCROLL and/or ZOOM function to manipulate a graphic. While it is foreseen that users will have little to no need to scroll or zoom graphical data, these options shall be available when the graphic exceeds the size of the screen.

3.3.3.2.3.1 Scrolling. The user shall have the capability to scroll graphical information through the use of the SCROLL-UP, SCROLL-DOWN, SCROLL-LEFT, and SCROLL-RIGHT functions. Guidelines presented in Section 3.3.3.1.3.1 shall apply to scrolling graphical information.

3.3.3.2.3.2 Zoom. The system shall provide the capability to enlarge or reduce the displayed graphical information. Guidelines presented in Section 3.3.3.1.3.2 shall apply to zooming graphical information.

3.3.3.2.3.3 Center. The user shall have the capability to activate a CENTER function which would relocate the center of a graphic to the point that the position cursor indicates without scrolling.

3.3.3.2.3.4 Full screen. The user shall have the capability to enlarge a graphic to the size of a full screen by activating the FULL SCREEN function. The purpose of this function shall be to eliminate the user activating the ZOOM-IN function multiple times before actually arriving at a graphic that is the size of the screen.

3.3.3.3 Tables. Tabular information may be used to clarify or replace textual information. When tables contain textual elements, those elements shall conform to the requirements set in this specification for textual information. Likewise, all graphical or illustrative elements within a table shall conform to the requirements in the specification for illustrative material.

3.3.3.3.1 Display of tables. When user interaction with information requires detailed comparison of ordered data sets, a tabular format for data display shall be adopted. If an oversized table (more than one screen) has to be constructed, the user shall have the capability to SCROLL the existing table.

3.3.3.3.1.1 Justification. Lists of alphabetic data shall be vertically aligned with left justification to permit rapid scanning. Numerical data shall be justified with respect to a fixed decimal point. In cases where there is no decimal point, the numerical data shall be right justified.

3.3.3.3.1.2 Column spacing. Consistent column spacing shall be maintained within a table. When data is displayed in more than one column, the columns shall be separated by at least 3-4 blank spaces if right justified, and by at least 5 blank spaces otherwise. For multiple occurrence fields with group headings, at least three blank spaces shall appear between groupings.

3.3.3.3.1.3 Row spacing. For dense tables with many rows, a blank line or other grouping feature (e.g., a solid line) shall be inserted after every five rows.

3.3.3.3.2 Selection of tables. The user shall have the capability to select an individual cells or a range of cells displayed in a table.

3.3.3.3.3 Manipulation of tables. While it is foreseen that users will have little to no need to scroll or zoom tabular data, these options shall be available when the table exceeds the size of the screen. The user shall have the capability to manipulate displayed tables by activating a SCROLL and/or ZOOM function.

3.3.3.3.3.1 Scrolling. The user shall have the capability to scroll tabular information, a row or column at a time, through the use of the SCROLL-UP, SCROLL-DOWN, SCROLL-LEFT, and SCROLL-RIGHT functions. Guidelines presented in Section 3.3.3.1.3.1 shall apply to scrolling tabular information.

3.3.3.3.3.2 Zooming. The system shall provide the capability to enlarge or reduce the displayed tabular information. Guidelines presented in Section 3.3.3.1.3.2 shall apply to zooming tabular information.

3.3.3.3.3.3 Resequencing of rows and columns. After initial display of the table, the user shall be able to restrict and resequence the fields (rows and columns) to be displayed. The user shall be able to sort the tabular data fields in ascending or descending alphanumeric order. Word (string) searches on any table in the data base shall also be supported.

3.3.3.3.3.4 Sorting and searching. After the system displays a table, the user shall be able to sort the data alphanumerically (either ascending or descending) using any of combination of fields as the key. The user shall also be able to perform a word search on any table that has been displayed.

3.3.3.4 User prompts/questions. Prompts shall be used to obtain context information from the user, based on some specific property that the user has observed. Prompts shall be presented to the user as questions which depend on the user's response. For example, the following question is a typical prompt that could be found in maintenance technical information: "Is there oil on the ground?", if the user answers "yes" then Task A would be presented; otherwise Task B would be presented. The user's response to the prompt shall make an assertion, which the display system software shall use to determine the user's information and sequence of presentation.

3.3.3.4.1 Display of user prompts. A standard symbol or layout shall be used with prompts to indicate to the user that an entry is required. The symbol or layout shall only be reserved for that purpose. The user's data entry area shall be close to the prompt or question.

3.3.3.4.2 Manipulation of user prompts. The user shall have the capability to change a response to a prompt in a procedure, thus changing the assertion made by the system software. To change a response to a prompt, the user shall have access to a menu that contains all of the current assertions.

3.3.3.5 Audio. Auditory displays may be differentiated into two types:

- a. non-verbal, auditory signals or tones, activated by the presentation system, and used as a cuing or augmenting stimulus to a visually displayed error messages, alerts, and
- b. computer-generated (i.e. synthetic) speech output or procedural information, activated by the user, and used primarily as a supplement to or substitute for the same procedural information presented visually.

3.3.3.5.1 Audio manipulation. The user may have the capability to request that audio codes be repeated. The user shall have control over the audio volume and on-off control of audio highlighting.

3.3.3.6 Video. Video sequences may be provided when motion is important for depicting the dynamic movement of fluids or energy through a network, or for conveying visual instructions on how to accomplish certain tasks.

3.3.3.6.1 Video manipulation. The user shall have the capability to access a video sequence.

3.3.3.7 Motion/animation. Means of presenting motion/animation may be provided but used sparingly, judiciously, and purposely. Fine adjustments can sometimes be more effectively shown than described. The movement of mechanical parts are frequently hidden from view but critical to proper task performance. The movement of fluids or energy

through a network can often be more effectively shown by motion than by static symbols (e.g., arrows).

TABLE 2. List of common user interface virtual functions.

Virtual Function	Definition	Specification Paragraph
SELECT	action to make a choice	3.3.2.1.1.
ENTER	action to finalize a selection	3.3.2.5.3.2.
CANCEL	action to deselect	3.3.2.1.1.
UP	action to move cursor up	3.3.2.1.2.
DOWN	action to move cursor down	3.3.2.1.2.
LEFT	action to move cursor left	3.3.2.1.2.
RIGHT	action to move cursor right	3.3.2.1.2.
SCROLL-UP	action to move scroll bar up	3.3.2.4.2.
SCROLL-DOWN	action to move scroll bar down	3.3.2.4.2.
SCROLL-LEFT	action to move scroll bar left	3.3.2.4.2.
SCROLL-RIGHT	action to move scroll bar right	3.3.2.4.2.
ZOOM-IN	action to enlarge text	3.3.3.1.4.2.
ZOOM-OUT	action to reduce text	3.3.3.1.4.2.
SYSTEM HELP	action to receive situation-specific help	3.3.2.3.7.3.
CONTEXT HELP	action to receive application help	3.3.2.3.7.3.
EXIT (QUIT)	action to end current application; close windows associated with application	3.3.2.3.7.1.
CLOSE WINDOW	action to close window	3.3.2.5.3.3.
OPEN WINDOW	action to open window	3.3.2.5.3.3.

MAXIMIZE	action to enlarge window	3.3.2.2.1.
MINIMIZE	action to reduce window	3.3.2.2.1.
RESIZE	action to change size of window	3.3.2.2.1.
UNDO	action to reverse most recently executed action	3.3.2.3.7.2.
CUT	action to remove a selected portion of data from the client area to the "clipboard" buffer	3.3.2.3.7.2.
COPY	action to copy a selected portion of data to the clipboard without removing the original data from the client area	3.3.2.3.7.2.
PASTE	action to paste the contents of the clipboard into a client area at selected location	3.3.2.3.7.2.
NEW	action to create a new file in a window	3.3.2.3.7.1.
OPEN	action to open a window on an existing file	3.3.2.3.7.1.
SAVE	action to save all current information	3.3.2.3.7.1.
SAVE AS...	action to save all current information under a new title	3.3.2.3.7.1.
PRINT	action to schedule a file for printing	3.3.2.3.7.1.

3.4 General Formatting and User-Interaction Features for the Display of IETMs. This section describes the formatting and user interaction for IETM content displays. IETMs are composites formed by combining primitive information entities (text, graphics, tables, and prompts) using the formats described in Section 3.3. IETMs will be displayed in the client area of a window and the user shall have the capability to interact with the information being displayed in accordance with the features described in this section in addition to the system features described in Section 3.3. Additional detailed presentation requirements unique to major IETM types (procedural, descriptive fault isolation, and parts information) are given in section 3.5. Features described in this section shall apply to all IETMs.

3.4.1 General display formats for IETMs.

IETMs shall be displayed in the Client area as described in Section 3.3 with the required title bar, content displayed according to one of the Presentation Templates described below, and an optional second title bar and footer bar for IETM functions also as described below.

3.4.1.1 Presentation templates. Basic presentation templates shall be used to display all IETM information. The following paragraphs describe these templates, which shall be generated by the IETM presentation system, based on information types and content. The templates apportion the remainder of the client area of a window to text and graphics. This text/graphic area shall occupy the width of the window. Its upper boundary shall be adjacent to the bottom of the window header area. Any conflicts in the amount of information to be included in a given window shall be resolved in favor of reducing visual clutter on the display screen.

- a. Template 1: All Text. Information that is all text with no graphics or tables shall be presented into a template with the entire text/graphic area of the window devoted to the text.
- b. Template 2: Side-By-Side Text and Graphics. In this template, the text/graphic area shall be divided by a thin vertical line, centered in the text/graphic area. The resulting window shall have two side-by-side areas whose sizes shall be determined at time of presentation. The text shall be displayed in the lefthand area and the graphics or tables in the righthand area.
- c. Template 3: Text Above Graphics Template. The text area of the window in this template shall occupy the upper portion of the text/graphic area, and the graphics or tables shall occupy the lower portion. The exact dimensions of the text and graphic areas shall be determined at presentation time. The text and graphic areas shall be separated by a thin horizontal line.

- d. **Template 4: All Graphics.** Information that is all graphic with no text shall be projected into a template with the entire text/graphic area of the window devoted to the graphic or table.
- e. **Template 5: Variable Text and Graphics.** This template shall be used for windows that require more than one graphic to be displayed with text or for windows for which highly integrated text and graphic presentation has been specified by the author. The text shall be placed, in general, in the upper lefthand corner of the text/graphic area. The graphics shall be placed to the right and under the text and any right and bottom borders shall be determined at presentation time. This template shall include an option for a text/graphics module, which shall consist of a combination of text, graphics, and callouts, laid out as an integrated display, with text increments located optimally with respect to the graphic, and with each callout extending from the graphic to the textual reference. However, the window shall not be divided into text and graphics sections.

3.4.1.2 Optional Second Header Line If specified in the Contract the top line in the client area shall be reserved for additional header information to be specified in the contract. This typically will consist of material such as an Alphanumeric Work Package Identifier or a specially generated code for purposes of reporting errors by displayed frame. The format of this line shall be compatible with the required title bar (Section 3.3.2.2.1.2). This line may be made to toggle with the menu bar using the MENU function. If the toggle feature is used to toggle the title bar, then the toggle shall apply to both the title bar and the second header line. (See Section 3.3.2.2.1.2.1)

3.4.1.3 Optional Footer Bar An optional Footer Bar may be located at the bottom of the frame in the client area. The use of this footer bar may be made mandatory by the procuring activity. The Footer information shall be displayed at the bottom of the frame in a region that is two character-cell heights tall and as wide as the frame. The footer bar is used in conjunction with the menu bar to display all of the interaction options to the user. All selectable options currently active at the time the screen is being viewed and which are directly related to the normal or main-stream operations of using the IETM to perform a maintenance function shall be displayed in the footer-bar area. Functions which are not active for the displayed frame shall not be displayed in the footer-bar area. The criterion for whether a function is considered main-stream is that the entire validated maintenance procedure may be performed using only the main-stream functions highlighted in the footer bar.

The footer bar shall be optimized to support delivery devices which use programmable or dedicated function keys and the footer bar cues the user that particular functions are assigned to physical keys and that those keys are active; however, it shall also support interfaces that

use the marked region in the footer bar as an active touch screen area or selection button for a mouse or other point-and-fire selection controller. When the footer bar option is utilized, active selection areas of the frame shall be in the footer bar area and not elsewhere in the client area (i.e., frame) unless a dialogue box or other active window is superimposed on the frame.

The options may be displayed using function name, icons, programmable-function-key labels (e.g., F2), or other visual prompts and shall be enclosed in a visual bordered box in the footer bar area. Icons with no attached verbal description may be included without the surrounding bordered box. There may be up to ten such boxes in the footer bar and they shall be lined up horizontally. The Footer information shall always be present while the Frame is activated. Options selectable by the user but not necessary for the main-stream presentation of the maintenance information may be included only in the menu bar. E.g., the menu bar can be used for functions such as non-standard EXIT, change display font size, BOOKMARK, or system HELP.

When a software function is assigned to a particular function key, a label containing the hard-key function label or the programmable-function-key number (such as "F8") along with a succinct description of the function shall be displayed in the footer bar area. The description shall not exceed 10 characters. The function key label, number, and/or description shall be displayed adjacently on the same horizontal line. Whenever possible, the same function shall appear in the same region of the footer bar (e.g., the NEXT and BACK functions should always be in the same location in the bar) even if this requirement calls for some blank space to be reserved in the bar when a particular function is not active.

Menus may be activated from the function boxes in the footer bar and may be either attached (i.e. in the pull-down format) or pop-up in accordance to the formats described in Section 3.3.2.3.

3.4.1.4 Display of Precautionary Information Precautionary information shall be presented by the IETM system to:

- a. attract the user's attention to practices, procedures, and conditions that could lead to injury or equipment damage;
- b. warn against performance of certain hazardous actions; or
- c. require specific steps leading to safe performance of a procedure.

3.4.1.4.1 Display Requirements for Precautionary Messages.

The precautionary message shall be displayed and treated as an Alert (See Section 3.3.2.4.3) with the following particulat formatting requirements. The Precautionary message shall be displayed overlaying or partially obscuring the information to which the precaution applies. Normal operation of the system shall not resume until the message is acknowledged. A function key shall be assigned for acknowledging precautionary messages in accordance with the Alert requirements.

Upon user acknowledgment, the message shall be erased, and the procedural information restored. An icon representing the precautionary message shall appear at the bottom of the display area, above the footer. The icon shall remain at the bottom of the display until the precautionary message no longer pertains to the information being displayed.

3.4.1.4.2 Precautionary Display Format Requirements.

The precautionary message shall be displayed in a rectangular area centered vertically and horizontally on the screen. The message shall be constructed as described in the following paragraphs, and as illustrated by Figure 9.

3.4.1.4.2.1 Color of Precautionary Messages.

Colors have been chosen for precautionary messages to alert the user to critical conditions. Where color is available, message colors shall be red for warnings, yellow for cautions, and cyan for notes.

3.4.1.4.2.2 Border of Message.

The border width shall be 5% of the screen height. The border shall consist of diagonal bars, alternating between white and the designated message color. The appropriate word identifying the message type shall appear in capital letters ("WARNING," "CAUTION," or "NOTE"). The precautionary word shall appear horizontally and vertically centered on the upper border of the precautionary message, and shall be in the largest font size.

3.4.1.4.2.3 Icon and Title.

The icon representative of the precautionary message shall appear centered horizontally within the upper message border.

Icons shall be designed and used in accordance with the Aerospace Industries Association Service Publications Committee PUBS-119. DOD Liaison Recommendation for Hazardous Material Warnings in Technical Data shall be used where applicable.

An icon shall remain at the bottom of the display until the precautionary message it represents is no longer applicable. The user may view the precautionary message in its original appearance and functionality at any time by selecting the icon. The message must again be acknowledged before the user can continue the procedure.

When a message has a title, it shall be displayed in the largest font size. The title shall be horizontally centered one character cell height below the bottom of the icon.

3.4.1.4.2.4 Text.

The content of the precautionary message shall be displayed within the border. The text shall have left, right, and bottom margins equal to 1 $\frac{1}{2}$ of the screen height. Messages containing two or more paragraphs shall have a blank line between paragraphs.

3.4.1.4.3 Format for Danger From Several Sources.

When precautions exist in separate categories for the same set of technical information, they shall be successively displayed in decreasing order of severity: that is, warnings first, followed by cautions and, finally, notes. Precautions in the same category shall be successively displayed. However, there shall be no requirement to determine an order of importance within the same category.

When related precautionary messages of the same category exist for the same block of technical information, it may be desirable to group them within a common border. The title shall indicate the 'combined danger. Figure 10 illustrates this situation for hydrazine.

3.4.2 User interaction functions with IETM. The purpose of this section is to describe in detail the standard functions required for electronically presented maintenance technical information. In addition to the common user interface functions previously described, the presentation system shall provide the capability for the user to activate this set of standard functions for selecting, manipulating, accessing, navigating, and entering data in the system. These are "virtual" functions which may be implemented in different ways by different presentation systems. One presentation device might have dedicated keys for each standard function. Another presentation device might provide software programmable function keys. A third presentation device might use a pointing device such as a mouse to select the standard functions from a menu bar. This specification assumes that the presentation device provides the user with the facility to select and activate all of the standard input functions described herein.

3.4.2.1 Function key selection. When a software function is assigned to a particular function key, a label containing the function key number (such as "F8") along with a succinct description of the function may be displayed on the screen. The description shall not exceed 10 characters. The function key number and description shall be displayed within two bordered rectangles, and shall be displayed adjacently on the same horizontal line.

3.4.2.2 Navigation. Presentation systems shall require a minimum number and type of user control actions. The user shall use a common set of commands to navigate and sequence through the information. The following are a minimum set of input functions which shall be available to the user to navigate and sequence all types of technical information. Precise definitions and specific requirements for the use of these functions in differing contexts is listed in Section 3.4.2.5.

3.4.2.2.1 Next. The NEXT function shall display the next section or frame of information that the user requires, based on the context of his situation. This function is only applicable when the information can be put into a meaningful sequence. It is analogous to paging forward in a printed document.

3.4.2.2.2 Back. The BACK function shall display the section of information that precedes the information at the current position within the sequence. This function is only applicable when the information can be put into a meaningful sequence. It is analogous to paging backward in a printed document.

3.4.2.2.3 Retrace. The RETRACE function shall permit the user to retrace the path through the sequence of screens that have been viewed, considering all branches, menu selections, etc. This function is like an audit trail and traces, in reverse, the exact path the user has perused through the data.

3.4.2.2.4 Return. The RETURN function shall enable the user to return back to a previous location from which the currently displayed information was accessed, or called. For example, if the user branches to a cross-reference from a maintenance procedure, the RETURN function will return the user to the original location in the maintenance procedure.

3.4.2.3 Data Access. Large sets of information, such as an entire view package, require flexible data access by the user. There shall be multiple data access paths provided to the user including, as a minimum, the following access methods.

3.4.2.3.1 Bookmarks. The user shall have the capability to mark any information element for later retrieval. The user shall be able to scan forward and return to the start. The user shall be able to use this function to establish an audit trail that clearly marks all of the

screens viewed during his/her maintenance activities. The user shall be able to view CREATE, DELETE, MODIFY, and GOTO bookmarks. When setting a bookmark, the user will be able to name the bookmark with his own alphanumeric name. Through the BOOKMARK function the user should be able to scan forward and return to the start and the user should be able to mark frames for possible later recall and return.

3.4.2.3.2 System hierarchy. The user shall have the capability to access information by using a system-subsystem-subassembly hierarchical outline.

3.4.2.3.3 Functional diagrams. The user shall have the capability to access information through the use of a functional diagram. Through the diagram, the user shall be able to move the cursor to the function of interest and activate the SELECT function. A menu containing the Content Data Model information types on that function shall appear. Once the user has selected the information type, a further breakdown of the information available on that function shall be provided.

3.4.2.3.4 Search and direct access. The SEARCH function shall enable the user to search for, and directly access, information by entering any one set of information keys into a dialogue box. In particular, the user shall be able to search for information by using any of the content describing attributes (i.e., name, item identification, and information type) as keys to search the database for all matching information, as well as any of the context describing attributes to narrow his search. The names may include standard system nomenclature, procedure names, descriptive information titles, part names, etc. The item identifiers may include system-subsystem-subject (SSSN) numbers, the reference designators, or part numbers. The information types may include any of the major information types (i.e., procedural, descriptive, troubleshooting, parts) or more specialized types (e.g., alignment, checkout, inspection, theory, schematic, etc.). Under the function of search and direct access, the user shall be able to find assignments, table of contents, forms, user lists, local directives, glossary, and annotations.

3.4.2.3.5 Level of detail. If required in the contract, there shall be two levels of detail for technical information offered to the technician. One level will provide a more detailed presentation and is tailored for the less experienced technician. The capability to access this level shall be provided through the MORE-DETAIL function. If a less detailed presentation of technical information is required the technician shall have the capability to activate the LESS-DETAIL function. The system shall provide the capability for the supervisor to limit, as appropriate, the level of access available to a given user.

3.4.2.3.6 Cross references. Whenever a displayed information element has cross-references or related information identified, the presence of those cross-references shall be indicated to the user by some encoding scheme. The user shall be able to access that related information by

some action such as "clicking" on the displayed item, or by selecting a cross-reference menu. When the cross reference is selected, a new viewport or window of information will appear on the screen over the original information. The user may exit the cross-reference information and to the original information display by using the RETURN function.

3.4.2.4 Options. An options menu enables the user to customize various aspects of your application. The options menu's content depends entirely on the needs of your application. An example options menu might contain the following:

3.4.2.4.1 Font. A maximum of three different Fonts will be available to the user in order to tailor his screen. All fonts shall contain both uppercase and lower case characters. Characters shall be displayed in the sans serif typeface. Fonts may be monospaced or proportional. The minimum font shall be at least .14 inches tall. The maximum font size shall be small enough to display 40 of the character set's widest characters, side by side, on a single line spanning the entire screen. The size of the medium font shall be the mean of the smallest and largest fonts. The medium font shall be the default font. Upon selecting a different font size, the text area of the display shall be cleared; the text shall be redisplayed in the same text area using the new font size.

TABLE 3. List of Virtual Functions for the IETM

Virtual Function	Definition	Specification Paragraph
NEXT	action to move forward to the following screen	3.3.4.2.1.1.
BACK	action to move backward to the previous screen	3.3.4.2.1.2.
RETRACE	action to review all screens which have been seen to lead to current state	3.3.4.2.1.3.
RETURN	action to return to screen before last branching	3.3.4.2.1.4.
CREATE BOOKMARK	action to create a bookmark for purposes of saving data before bookmark	3.3.4.2.2.1.
DELETE BOOKMARK	action to erase specific bookmark	3.3.4.2.2.1.
MODIFY BOOKMARK	action to change bookmark	3.3.4.2.2.1.
GO TO BOOKMARK	action to go directly to a specific bookmark	3.3.4.2.2.1.
SEARCH	action to find data about aircraft with limited information available	3.3.4.2.2.2.
MORE-DETAIL	action to receive novice track information	3.3.4.2.3.4.
LESS-DETAIL	action to receive an expert track of information	3.3.4.2.3.4.
DIRECT ACCESS	action to receive SSSN hierarchy, bookmarks, glossary, index	3.3.4.2.2.2.

3.4.2.5 Standard Function Definitions

NOTE TO REVIEWERS OF THIS DRAFT SPECIFICATION

The list of standard functions to be employed in an IETM is known to be a subject on which there are many differing opinions among the qualified experts. It is fully expected that this list will change and expand. This particular section is designed to list all allowable functions and to give each a standard definition so that if it is used it will mean the same things across all standard IETMs. There may be differences between section 3.3.4 and 3.3.5 in early versions of this draft which will be corrected after final review.

The following special functions may be available to a technician using the Work-Center Electronic Display Device whenever they are applicable to the IETM being viewed. When used, the function shall be named as below and the meaning of that special function shall be consistent to the description listed. Those functions marked below as mandatory shall be active at all times and in all applications when displaying IETM information.

These special functions shall be exercised either by means of direct selection from the displayed screen button, by dedicated special-function keys labeled with the function involved (e.g., Next, Help), or by program assignable function keys as spelled out on the viewed frame.

Some of these functions may be used together when the first functions call up a Pop-Up window and the context of the first function shall dictate the particular meaning of the second function selection (e.g., Next after a Help key means the next screen of help and not the next frame of technical content.). When this is the case, the control notation visible on the screen should be modified (e.g., shaded out) to eliminate any confusion. Uses of these special functions are described below:

3.4.2.5.1 Help (Mandatory)

When selected, the Help function shall display descriptive information corresponding to the context of the information currently being displayed. This function shall typically display a Pop-Up or Pull-Down menu of Help choices from which the user can select with the Context-Sensitive option premarked for immediate selection if there is any. The Exit function shall be used to exit the help display.

3.4.2.5.2 Back

Exercise of the Back function calls back for display of the information element (e.g., frame or step) which logically proceeds the present view. In an unbranched Procedural sequence, the previously displayed frame would normally be the screen or step with the next lower sequence index. In general, the Back function simply offsets the last use of the Next function. At times such as the first step of a branched sequence, the back function will not be operable as there may be no single previous logical step.

3.4.2.5.3 Access (Mandatory)

Exercise of the Access special function, causes a pop-up menu to appear listing the available options for accession or calling. These menus may be nested. Selections would normally include both internal accessions and external accessions. A audit trail of these accessions shall be maintained whenever possible and logically sensible allowing the user to return to the screen or information segment from which the accession was invoked using the Return function.

3.4.2.5.4 Bookmark (Mandatory)

The EDS software shall enable the user to mark any currently displayed information segment using the Bookmark function. After selecting the Bookmark function, the system shall allow the user to enter a comment about the Bookmark and mark that segment for subsequent return or view a list of all previous bookmarks. Upon displaying an information segment which had been previously bookmarked, an icon shall be displayed in the footer section of the screen that, when selected, shall allow the user to read or edit the associated comment.

The Bookmark must allow the user to return to the logical information segment being viewed at the time the Bookmark was entered and as close to the exact screen or step as possible.

3.4.2.5.5 Next (Mandatory)

Exercise of the Next function causes the next screen or step in logical display sequence to be displayed. It would generally be used in unbranched Procedural or Descriptive sequences, but not in situation when a selection is required for a branch. Whenever there is more than one logical next step the Next function shall display a message indicating that a selection must be made. If the only next step is to exit or return, then a message to that effect shall be displayed on the screen (e.g., "Hit Return to continue.").

3.4.2.5.6 Notepad

The EDS application software may be constructed so that a technician can create and display a series of personal notes relating to the IETM information being displayed on a screen. The purpose of such a Notepad function is to permit a technician to store additional information of value to him (e.g., maintenance history of a given system; a list of access locations for frequently used information). This function shall not permit changes or modifications to the procedures or descriptive information of the basic IETM or View Package itself. Selecting the Notepad function shall allow the user to enter an appropriate note using the device's alphanumeric data-entry capability (e.g., keyboard). When notes have been entered about a particular screen or procedure step, it shall be noted by an Icon in the control area of the display and the user shall be able to view or edit that note in a Pop-up window on his display by selecting the Notepad function during a Troubleshooting or maintenance procedure.

When used, the Notepad-function software must be able to associate the creator of the notes with the actual user and display (or prevent the display of) the proper set of notes.

3.4.2.5.7 Retrace (Mandatory)

The Retrace function shall permit the user to chronologically retrace (or backtrack through) the sequence of screens that have been previously viewed in the reverse sequence with which they were viewed including through branch selections, Menu selections, etc.

3.4.2.5.8 Return (Mandatory)

The Return function enables the user to return to a previous location from which the currently sequence of information was accessed, or called. For example, if the user branches to a cross reference (via an Access call) from a maintenance procedure, the Return function shall return him to the original location in the maintenance procedure.

3.4.2.5.9 Select

The Select function provides the capability to select items from Menus or objects from illustrations and to verify selection by highlighting that area. Depending on the method used for information selection, the Select function may be a specific navigation function or be integrated into a specific method of selection.

3.4.2.5.10 Cancel (Mandatory)

Selection of the Cancel option shall "undo" the previous destructive entry or selection as though it were never entered. In data-entry mode it shall erase any entries just made by the user and restore the current display to the previous version of the data overwritten, if any.

3.4.2.5.11 Exit (Mandatory)

The Exit function shall stop execution of the IETM presentation/display program and perform an orderly exit from the IETM application program. This function shall be executable from any position in the IETM.

The user shall then have the option to save the current state before exiting, including the current location in the IETM his current context, the current state of any diagnostic procedure, etc., for resumption when the same user signs on the EDS again. A description of this option shall be clearly spelled out and displayed along with the request for an appropriate selection to be made (e.g., Yes or No).

If this option is not selected then the user shall exit after saving or deleting (as required by the operating software for the IETM application) all relevant current variable information.

The Cancel function must always be available to negate the Exit command if Cancel is selected (i.e., hit) immediately after Quit was selected.

Note: In order to execute an immediate exit without retaining the last position or saving any current information, the Quit function shall be used.

3.4.2.5.12 Quit (Mandatory)

The Quit function shall execute an immediate exit without retaining the last position or saving any current information.

3.4.2.5.13 Yes

Answer to a question allowing a Yes response shall be done by a special function key.

3.4.2.5.14 No

Answer to a question allowing a No response shall be done by a special function key.

3.4.2.5.15 Print

The Print special function causes the supplementary printer to prepare hard copies of the designated TI print-package increment appropriate to the currently viewed IETM information. This print package (e.g., check list, "B"-sized schematic, etc.) will have been specially formatted for printed output by the authoring activity and not merely a screen-print. The displayed IETM must indicate that a print package is available at that time in the presentation.

3.4.2.5.16 Access Data

When a multitrack presentation is involved and the expert user has an option to select a detailed description or an overview of procedural information, this function shall be displayed to allow the user to access the detailed information before continuing on the less detailed track.

3.4.2.6 Icon conventions. The system shall use icons as one means of indicating available options. Icons shall be displayed using meaningful and appropriate colors from the currently available color set or gray tones. An precautionary information icon shall remain at the bottom of the display until the precautionary message it represents is no longer applicable. The user may view the precautionary message in its original appearance and functionality at any time by selecting the icon. The message must again be acknowledged before the user can continue the procedure.

3.4.2.7 Locator illustrations. Locator illustrations are special purpose graphics to aid the user in locating a major equipment unit in reference to its surroundings. For example, while viewing a small panel in a cockpit, the user may activate the optional locator illustration to provide a reduced view of the cockpit with the panel highlighted. Locator illustrations shall enable the user to find the equipment items (part, switch, control, indicator, assembly, etc.) referred to in the technical information. A locator illustration shall consist of a labelled graphic together with required callouts. The locator illustration shall show what a particular item looks like and illustrates its relationship to its surroundings (equipment units). A locator illustration may be included as a option, selected by the use of a function key, or as part of a procedure or descriptive information presentation. Major-equipment unit-locator illustrations show the relationship of the major equipment unit to the overall equipment or system. Equipment-item locator illustrations show the relationship of equipment items (parts, switches, controls, indicators, assemblies, etc.) to the major-equipment unit.

3.4.2.7.1 Placement of locator illustrations. Placement of equipment items such as parts, switches, controls, indicators, and other items are shown on illustrations which shall be fully integrated with the associated technical information.

- a. The individual equipment items (parts, switches, controls, indicators, and other items) must be shown in context to the major equipment units. The title of the major-equipment unit must be shown on the illustration in all-upper-case letters.
- b. Index numbers (callouts) must be assigned on the equipment-item locator illustration either: (1) in clockwise sequence, or (2) in the sequence that the item is discussed in the Procedural Steps.
- c. Major-equipment unit-locator illustrations and equipment-item locator illustrations may be combined in a successive fashion (to permit location of an item with increasing precision) into a fully integrated text/graphics module.
- d. Equipment-item locator illustrations. In procedural information, a step must be keyed directly to the relevant part, switch, control, indicator, or other item by a leader line. The title of the major-equipment unit must be shown on the equipment-item locator illustration in all-upper-case letters.

3.4.2.7.2 Successive locator illustrations. Successive locator illustrations may be used to lead the user systematically from the large, overall view to successively lower-level views. A successive locator series shall assist an inexperienced technician pinpoint the location of a part through use of a logical search routine - from general to specific. The successive locators shall take the user from the most general (and familiar) view of the equipment to the location of a specific small item. Item exploded views shall be used as locator graphics only where further disassembly is required. Sequence arrows used in such a progression (from graphic to next graphic) shall be:

- a. Tapered
- b. Open-bodied (not blacked in)
- c. Unnumbered
- d. Headed within 1/4 inch of enlarged view.

3.4.2.7.3 Format for optional locator illustration. When an optional locator illustration is appropriate, a visual signal shall be displayed informing the user that a locator illustration is available. When the user activates the locator illustration, the illustration shall be displayed in sufficient resolution for the user to quickly identify the surroundings and the item to be located with respect to the surroundings. A callout may optionally be used to emphasize the location of the item to be located. In some cases, one locator illustration may be displayed from within another. For example, one

locator illustration used to locate a fuse underneath an outer panel may reference a second illustration to locate the panel on the exterior of the aircraft.

3.4.2.8 Callouts. Specific features of interest shall be called out (pointed out) with leader lines on illustrations. Specifically, all items referred to in the technical information shall be indicated on the appropriate illustration by a callout. Callouts shall consist of leader lines (with arrow heads) drawn from the index number to the equipment item. The following provisions for callouts shall be followed:

- a. Callouts and Index numbers on illustrations shall have a leader line or sweep arrow connecting the number to the correct point on the illustration.
- b. A callout shall only be displayed if it corresponds to the step currently highlighted in the text area of the display.
- c. Callouts shall be keyed to the steps of a procedure or individual descriptive statements.
- d. Callouts and identifier numbers shall not be crowded into spaces between graphic elements.
- e. Leader lines shall be either straight or have one bend at an angle of 45 degrees. They may cross drawing lines. If the leader line has a 45-degree angle, it shall be drawn with the angled end pointing to the graphic. Leader line width shall be three times greater than that of drawing lines, and shall be of different color or shade than the drawing lines.
- f. Use of part names or other graphic element textual identifier may be used as a label instead of index numbers but the label must be identical to that used in the associated text.
- g. Leader lines shall be straight rather than angled wherever possible.
- h. Leader line should not cross drawing lines if an alternative is possible.
- i. Leader lines shall not cross or come in contact with other leader lines nor shall they obscure essential details on the subject matter graphic.

3.5 Special requirements for major information types. The following types of information have certain special requirements in addition to the general requirements of Sections 3.2 through 3.4. To assure uniformity of information presentation and modes of interaction with the EDS, it is critical that IETM developers adhere to these special

requirements closely. The major information types detailed below include:

1. Procedural Information
2. Troubleshooting Information
3. Parts Information
4. Descriptive Information
5. Operational Information

3.5.1 Requirements peculiar to procedural information. Procedural information shall be directive in form. It shall be used to instruct an end-user how to operate, test, or repair a system; or carry out a logistics-support procedure. It includes information provided in a step-by-step manner so that technicians can carry out processes of weapon-system operation, fault verification, fault isolation, corrective maintenance, planned maintenance, installation, inspection, checkout, and test. There are four basic types of procedural information:

a. Mechanical Procedure.

Used to present mechanical instructions for such activities as disassembly, lubrication, repair, periodic maintenance, packaging, and shipping.

b. Operating Procedure.

Used to present operating instructions for all anticipated operating conditions, including such activities as starting, placing in operation, operating, placing on standby, and shutting down.

c. Test Procedure.

Used to perform all test, checkout, and inspection functions for such activities as operational checks, periodic maintenance checks, alignments, and calibration checks. In general, a test or checkout procedure assesses the operational condition (working properly or defective) of a single part, equipment subsystem, etc. Includes Fault Verification.

d. Troubleshooting Procedure.

Consists of a step-by-step procedure used to isolate an equipment fault (Fault Isolation) based on a fault symptom, so that Corrective Maintenance may be carried out.

3.5.1.1 Content requirements for procedural information. Procedural technical information includes the individual directive information elements (i.e., steps) of the procedure plus additional supporting material which is presented as an essential part of the procedure information presentation as follows.

3.5.1.2 Organization of content for procedural information. Procedural information involves the presentation of maintenance information in a step-by-step fashion. The structure for procedural technical

information involves dividing the procedures into tasks, subtasks, and steps. A task is a collection of subtasks directed toward accomplishment of a specific objective. Each new task or subtask shall begin on a new frame, with a header set apart from the rest of the frame by a border. In terms of content, each task involves closely related activities. Each subtask includes all steps required to achieve a specific objective, usually within a definite period of time. For example, the task

"REMOVE AND INSPECT CABLE REEL ASSEMBLIES"
consists of two Subtasks:

REMOVE CABLE REEL ASSEMBLIES and **INSPECT CABLE REEL ASSEMBLIES**. While all steps in this task are closely related, the subtasks are generally done sequentially, and their specific objectives differ.

3.5.1.3 Titling requirements for procedural information. The following title and labeling information shall be associated with a procedure tasks and subtasks. It is used primarily for window labeling upon presentation.

3.5.1.3.1 Task title. Wording of the task title shall be identical with the wording used in the task description in the Detailed Task Analysis Summary of the LSAR as specified in MIL-STD-1388/2. If no LSAR task title is available the task title shall consist of a verb followed by a noun or noun-phrase object. It shall be a concrete, specific, terse (fewer than 7 words) title that uniquely identifies which increment of maintenance performance the task involves. In the above example, **REMOVE AND INSPECT CABLE REEL ASSEMBLIES** is the task title. Each task title shall be unique.

3.5.1.3.2 Subtask title line. Consists of a subtask number (Arabic) and upper-case title (e.g., "SUBTASK 1. REMOVE REEL ASSEMBLIES"). Subtasks are numbered sequentially throughout a task, which may be divided into as many as seven subtasks. A subtask title is structured in the same manner as a task title and uniquely identifies the material which it heads. Subtasks may be divided into as many steps as needed.

3.5.1.3.3 Step number. Each step within a subtask shall be numbered with Arabic numerals consecutively except for some troubleshooting procedures where some other numbering sequence may be appropriate. The approval of the acquiring activity is required to use any other alternate numbering system.

3.5.1.4 Supporting material for tasks. In addition to the individual steps for a task, the procedure must contain the following information, which, in general, shall be displayed before the steps are viewed.

3.5.1.4.1 Procedure applicability statement. Any procedural task presented shall refer only to the equipment model range or sequence to which the particular item of procedural technical information applies. When a procedure does not apply to all existing models, this fact must be prominently stated and the applicable equipment model range

identified. In such a case, the IETM system must also incorporate the requirement that the technician enter the applicable system or equipment model number, serial number, or aircraft tail number, as applicable, in such a way that only entry of the appropriate number will permit the sequential presentation of procedural information to proceed. Such a control shall be based on established designations, such as model designation, part number, serial number range, or similar means; serial numbers should, however, be used only as a last resort. Indefinite categories such as "early serial numbers" or "some late models" are not acceptable.

3.5.1.4.2 Initial Setup. The initial setup shall be provided at the beginning of every new task. The initial setup lists information the technician must know before starting a task. It is to be headed as follows:

INITIAL SETUP

all upper case, boxed, at the left margin. All lists provided as part of the initial setup shall be headed by individual underlined titles, using upper-case initial letters with successive letters in lower case. Information presentation in each window shall avoid crowding; as many frames may be used for each initial setup as necessary. (F) This information shall be referred to as "Input Conditions."

3.5.1.4.2.1 Applicable equipment configurations. If the procedure does not apply to all equipment configurations, this section shall identify the configurations involved. If all configurations are involved, the entry shall be "ALL". Serial-number compatibility between hardware under repair and IETM shall be automatically provided for during the initial IETM information access by the technician. Such terms as "on later equipment" and "on early serial numbers" are not acceptable.

3.5.1.4.2.2 Test equipment required. The government approved test equipment applicable to the required task shall be provided. Equipment shall be listed by nomenclature and Joint Type Electronics Designation System (JTEDS), or Aeronautical Equipment Identification Designators (AN/AEID) type designation, if assigned, or commercial or manufacturers designation if the JTEDS or AN/AEID type is not assigned. Nomenclature shall include equipment capacity, range, etc. If alternate equipment can be used, the term or equivalent will follow the nomenclature. If no test equipment is needed, the entry shall state "NONE". If an equivalent alternate piece of test equipment can not be used, the notation "No Substitution" shall follow the item name and description.

3.5.1.4.2.3 Tools required. A list of tools by name and part number, or the citation of a standard tool kit, with its number shall be provided. If commonly available alternative tools are equally applicable, they shall be listed as well.

Example:

Torque wrench 5762-124-3457.

3.5.1.4.2.4 Materials, consumable/expendable items, mandatory-replacement parts. Sealant, lubricants, replacement lamps, gaskets, seals, cotter pins, lockwire, etc., are considered consumable/expendable items. A list by name and part number of all necessary consumable items, support materials, and mandatory-replacement parts, together with the quantity or size needed, when applicable, shall be provided.

Examples:

Switch	MI-M825085(3)
Cleaning Solution	FSN 384652 (1 quart)

If no materials, expendable items, or mandatory-replacement parts are required, the entry is "NONE".

3.5.1.4.2.5 Support equipment required. A list by name and part or model number of support equipment required to perform the task, including ground support equipment for aircraft maintenance shall be provided. If no support equipment is required, the entry is "NONE". The number of items of each type of support equipment shall also be provided. Examples of such support equipment include stands, auxiliary power, jigs, lights, screens. If an equivalent alternate piece of support equipment can not be used, the notation "No Substitution" shall follow the item name and description.

3.5.1.4.2.6 Personnel required. The minimum number of technicians required to perform the task effectively shall be provided. When more than one person is required for a given procedure, a general description of the relative role of each technician in performing the tasks, and a designation of his location and responsibilities shall be provided. Action requirements providing individual task duties shall be spelled out in detail in the actual task descriptions. Personnel listed shall be identified in terms of their specialties (rates and ratings) whenever possible. This information shall correspond to that provided by the LSAR. Any specialties required to perform the procedure shall be listed in terms of the appropriate Navy Enlisted Classification (NEC), Air Force Specialty Code (SEC), or Army Military Occupational Specialty (MOS). Examples:

EM 1 (Electrician's Mate 1st Class)
24480 (Remove, Test and replace Defective Components in automatic Degaussing Panels)

AE 3 (Aviation Electrician's Mate 3rd Class)
79265 (Apply Corrosion Preventive Compounds)

(Note: The parenthetical explanations above are added only to make the examples clear. Ratings and NECs would be listed only by number in the actual technical information.)

3.5.1.4.2.7 Special skills and knowledge requirements. A list of all special skills and knowledge needed, beyond those taught in the usual training courses; for example, a technician may be able to service a camera, but not have the special skill needed for disassembly and cleaning of a lens element. Once a list of such skills for all Tasks is assembled, an agreement shall be reached with the Government as to which of the procedures involved should be incorporated directly into the IETM. If such a procedure is not incorporated into a IETM, this Section shall provide a reference to relevant technical or training material. If special skills requirements do not exist or if the procuring activity determines that all technicians having access to the presented material are trained in the special skills and knowledge required, the heading may be omitted.

3.5.1.4.2.8 Time required. An estimate of the time required to perform the task, given to the nearest minute, shall be provided. If the procedure has several subtasks, the time for each subtask shall be listed, as well as total time. If more than one technician is involved, separate estimates shall be provided for each. Estimated time to complete individual steps may also be provided.

3.5.1.4.2.9 System preparation checklist. A checklist of all tests which should be performed by the technician to assure that all preparations have been performed prior to the start of the procedure, particularly those involving personnel safety and prevention of equipment damage shall be provided. When no system-preparation checklist is required (e.g., one has been presented in the previous task statement), the entry may be omitted. Examples:

4-1 Remove RF cable before disconnecting the antenna cable.

5-2 Turn off all power before starting.

3.5.1.4.2.10 Special environmental conditions. A list of any special environmental conditions needed shall be provided. These conditions may include: ventilation, lighting, temperature, noise level, EMI, cleanliness, air conditioning.

3.5.1.4.2.11 General safety instructions. A statement of any general safety information that applies throughout the task. Formal NOTES, WARNINGS, and CAUTIONS shall precede those steps which expose personnel to hazard of any kind, or which could cause equipment damage if improperly done. If no general safety instructions are required, this entry may be omitted.

3.5.1.4.3 Confirming events (Quality Check). Confirming events are indications which are not necessarily steps of the task or subtask

itself, but are necessary to provide assurance that the task has been performed correctly. They confirm the correctness of the technician's actions and confirm that the equipment is operating properly. Such confirming events shall be included at the end of every appropriate task or subtask which precedes the final reassembly of the system (e.g., before covers or cases are reinstalled) so that the operator or technician can be sure that he has done the subtask correctly. All subtasks involving confirming events shall be labeled "QUALITY CHECK" as part of the subtask title. In such a case the IETM shall incorporate instructions that such quality-assurance procedures are to be carried out by a qualified quality assurance inspector before the technician proceeds to the next step. Example:

QUALITY CHECK:

Check that wheel (6) turns freely.

Check that lights (2) go on when switch (1) is in the "ON" position.

Examples of tasks which require quality checks include those in which torque values must be set or gauge limits must be between established limits; and those in which the component worked on will be subsequently covered by a panel, hatch, etc.

3.5.1.4.4 Safety considerations in presenting procedural information. All procedures shall be made as safe to perform as possible. To more greatly assure safety, the following guidelines shall be observed:

- a. Whenever possible, actions shall be accomplished with equipment in a "shut-down," isolated condition. Specific subtasks and steps describing the shut-down process shall be included.
- b. No task or subtask ending shall leave any portion of the equipment in a dangerous condition unless adequate warnings are posted for all individuals likely to be affected.
- c. Steps directing removal of voltage or pressure shall be explicit as to which switches or valves are intended and shall include "tagout" action in the same step; e.g.,
"Turn off and tag 400 Hz exciter circuit breaker."
- d. Where components capable of holding a charge are included in the circuitry, steps shall be provided to direct discharge of such components, e.g.,
"Short high-voltage capacitor (12) using shorting probe (13)."
- e. Task procedures shall include steps to restore equipment to a safe operation condition, with appropriate tests to assure that the steps involved have been successfully accomplished.
- f. Warnings shall be prominently inserted in the procedural statements wherever needed. Requirements that the technician

attach warning labels to equipment being worked on shall be included in procedural steps wherever indicated.

3.5.1.5 Level of detail required for procedural information. Procedural information shall be written to the level of detail specified in section 3.1.1.1. However, in the case of job-performance technical information a reference source which the user can consult for more information shall be provided.

3.5.1.6 Style requirements for procedural information. The paramount considerations in preparing procedural information are accuracy of technical content and ease of understanding. Language shall be free of vague and ambiguous terms, and shall use the simplest words which convey the intended meaning. All essential information must be included in the IETM, and made readily accessible to the user.

3.5.1.6.1 Types of procedural statements. Procedural information shall be presented using action statements or indication statements.

a. **Action Statements:** Action statements shall consist of an action verb and an object or item upon which action is to take place.

Example:

Mechanical Procedure

1. Using a No. 8 Phillips screwdriver, loosen eight captive screws (1).
2. Open access-door assembly (2).
3. On antenna mount (3), disconnect coaxial-cable connector (4).

END OF SUBTASK

Statements presenting steps in mechanical procedures shall use only action statements.

b. **Indication Statements:** Indication statements shall present the name of an indicator which the user reads or observes and the indication which should be obtained. The indication shall be the normal or expected visible behavior when the equipment is functioning properly. Any values and tolerances necessary to evaluate the reading shall also be given.

Example:

Test Procedure

1. Set master switch (1) to ON.
INDICATION: Battery indicator (2) lights.
2. Set exterior light switch (3) to ON.
INDICATION: Two exterior lights (4) light.

END OF SUBTASK

Using a VTVM, measure the voltage at Test Point 4. **INDICATION:** At T4, VTVM reads $\pm .05$ volts.

The first of these statements is an action statement. The second is an indication statement. Statements presenting steps in operating and test procedures shall use action statements followed by indication statements.

3.5.1.6.2 Style for presentation of steps. Steps shall be numbered consecutively with Arabic numerals throughout a task or subtask. Steps shall be lined up five spaces to the left of the task or subtask number.

Example:

SUBTASK 1. START ENGINE.

1. Insert key (1) into the ignition (2).
2. Turn key (1) clockwise to START.
3. When engine starts, turn key counterclockwise to RUN.

Simultaneous actions or indications shall be included in the same step.

3.5.1.6.3 Standard statements for steps. Standard sentences for presenting steps shall be used where statements are very similar, as in the case of repetitious steps and test-equipment instructions. For example, sentences used for repeatedly directing use of a particular item of test equipment may be the same except for the:

- a. point of test;
- b. expected result; and
- c. "Where-to-go-next" statement.

3.5.1.6.4 Avoidance of superfluous information. Any procedural statement shall present only the information necessary for completion of a task or information which is directly helpful in preventing an error. A statement of a subtask step shall be limited to:

- a. a single operation;
- b. repetitions of a single operation; or,
- c. several operations which must be carried out simultaneously.

3.5.1.6.5 Procedures involving more than one user. Procedures which must be performed by several users working together shall be presented in a manner which integrates the actions and observations of each user into a single sequence of steps. Instructions for each action and observation composing a step shall identify the user responsible for accomplishing it. More specifically, the requirement for more than one user occurs when:

- a. Cooperation, coordination, or other teamwork is necessary under the direction of a supervisory user.
- b. Large or heavy items must be handled, a procedure which would be dangerous or difficult for one person.

c. A user must make observations or take actions in conjunction with actions of a primary user, at some location out of sight or reach of the primary user.

When more than one user is involved in a given procedure, each step shall be prefaced by a statement as to who is to perform it. The author of the IETM shall prepare the technical information so that a single EDS provides instructions for all users involved in carrying out the procedure. If more than one EDS is used, the information displayed shall be identical.

Example:

Technician A: Set MODE switch (1) to STAB.
Technician B: Turn GAIN adjust (7) until fully clockwise.
Technician C: Note in which direction pointer (4) moves.

In cases where coordination and communication are required, the following shall apply:

a. Situation 1: When one technician may not start a step until the second technician completes a given step. An instruction shall be provided (1) to the first technician, requiring him to delay starting his step until the second technician indicates completion of the second technician's part of the step and notifies the first technician to start; and (2) to the second technician, requiring him to provide this notification when he completes his part of the step. Such instructions shall be incorporated into the step itself. Where environmental conditions require special reporting methods (i.e., in a high-noise-level situation), a description of the nature of the notification shall be specified. Examples:

"Report when ready to observe pointer."

"Do not start until technician A reports that he has set MODE switch to STAB."

b. Situation 2: When one user performs a given step and a second user checks the equipment response to the step. An instruction shall be provided to the first user to delay starting a step until the second user is ready. An instruction shall be provided to the second user indicating that the step is in response to an action by the first user, and directing the second user to report readiness to perform the step. Instructions shall also tell the user when to report.

3.5.2 Requirements peculiar to troubleshooting information. The fundamental logic for interactive troubleshooting technical information may be based on predefined fault isolation sequences or dynamically computed fault isolation sequences.

3.5.2.1 Content requirements for troubleshooting information.

Troubleshooting technical information shall be designed to permit direct access to the relevant corrective-maintenance procedures at whatever level of fault isolation the user judges to be adequate. Specifically, the user may call an appropriate procedure at any level, even though the fault isolation procedure has not yet proceeded to final determination of a faulty component. All information related to a particular symptom, test or procedure shall be available to the user at all times during fault isolation including:

- a. other associated faults;
- b. associated test and rectification procedures;
- c. associated text and graphics;
- d. associated input conditions and follow-on tasks.

3.5.2.2 User interaction requirements for troubleshooting information.

The user shall be able to manually enter symptoms or automatically retrieve them from the system. The user shall be able to enter test results and responses. This shall be required before the user may proceed to the next procedure. The user shall also be able to modify test results at a later time. A range of acceptable values may be provided for test results. The user shall be able to navigate forward and backward through the fault isolation model.

3.5.2.3 Presentation requirements for troubleshooting information.

Presentation of test and rectification procedures and setups, listing of alternative results to be expected from tests, identification of faulty components, etc., shall be presented in clear, unambiguous, standardized language such as that required for presentation of procedural information. The user shall have access to all information which will assist in the completion of the procedure. Troubleshooting procedures will be presented in such a way that the user can distinguish between:

- a. a recommended procedure;
- b. plausible procedures;
- c. unlikely procedures;
- d. exculpated (eliminated) procedures.

3.5.2.4 Requirements peculiar to predefined fault isolation sequences.
This approach shall represent the static fault isolation procedures in a manner similar to those found in fault isolation manuals. The user shall use an observed symptom to locate the correct troubleshooting procedure which will lead to the suspected fault. Static fault isolation sequences shall be structured as a fixed sequence of procedures and tests. Following a test a response shall be required to proceed to the next procedure which may be another test or a rectification procedure if the suspected fault has been isolated.

3.5.2.4.1 Presentation requirements for predefined fault isolation sequences. A list of tests and a list of rectifications for a

particular symptom shall be available for the user to select from. The mean time to replace/repair for components which may contribute to the fault shall be displayed. After a fault has been isolated and rectified, a checklist of all testing and verification procedures shall be presented.

3.5.2.5 Requirements peculiar to dynamically computed fault isolation sequences. This approach shall provide computer-aided troubleshooting which will make recommendations to user as to the appropriate action to take in fault isolation and rectification. The user shall use an observed symptom to initiate the troubleshooting process. The system shall then recommend tests or rectifications based on the outcome of functional checks after a previous rectification or test has been completed. These recommendation shall be based on fault probabilities, component mean time between failure (MTBF) rates, time to repair, and other maintenance constraints. The user shall be able to select actions based on personal experience or select the system generated recommendations to accomplish fault isolation.

3.5.2.5.1 Content requirements for dynamically computed fault isolation sequences. The information needed for computer-aided fault isolation shall include:

- a. all fault states associated with a symptom;
- b. all outcomes of associated tests;
- c. repair times for suspected components;
- d. MTBFs associated with suspected components;
- e. fault probabilities for fault/symptom relationships;
- f. completion times for tests and rectifications;
- g. availability of parts and equipment;
- h. all critical faults;
- i. relationships between components of suspected systems.

3.5.2.5.2 User interaction requirements for dynamically computed fault isolation sequences. The user system shall be able to interface directly with the item being repaired, where possible. The user shall be able to view a repair history of the item being repaired.

3.5.2.5.3 Presentation requirements for dynamically computed fault isolation sequences. In troubleshooting sequences, an abbreviated setup shall be presented as part of the procedure for each test sequence, supplying setup information for that test only. To support the user in carrying out the above functions, the IETM must provide test instructions (procedures including initial setup) for the test in a logical sequence so that the user may successively reduce the number of possibly defective components in an organized way. The EDS shall display the range of test results which is to be considered satisfactory. Based on entry of the technician's test results into the program, the IETM Display shall automatically present the optimal next test, based on the weapon-system maintenance-dependency charts as

modified by taking into account known MTBFs, test times, maintenance history, or other heuristic factors.

The system shall be able to display the following:

- a. a list of tests with associated probabilities of fault isolation and the estimated time to perform each test;
- b. a list of rectifications with associated probabilities of fault isolation and the estimated time to preform each rectification task;
- c. a list of interleaved tests and rectifications with associated probabilities of fault rectification and the estimated time for completion;
- d. a functional block diagram of suspected systems.

3.5.3 Presentation of parts information. All IETMs shall incorporate all required supporting information [of the type which, in conventional technical manuals, has usually been included in a separate Illustrated Parts Breakdown (IPB)]. In general, the IETM must be designed to (1) permit unambiguous identification of all replaceable or repairable parts; (2) show precisely the physical relationship of this part to other parts of the system; and (3) provide to the technician all nomenclature data required to order the part through the use of the automatically prepared parts-ordering "form" (POF) capability of the Work-Center EDS. IPBs shall illustrate each part using line drawings, and shall show its physical relationship to adjacent parts.

3.5.3.1 Accessibility of parts information. Parts information shall be made available to a technician:

- (1) based on (a) a locator diagram, or (b) parts shown on any logic-flow diagram or circuit diagram, or (c) parts cited in any statement in the technical information; or
- (2) as a response to a keyed-in request for information, using a part designation in any of its available forms.

3.5.3.2 Parts identification. Until a standard method of parts enumeration is achieved, access to parts data shall be provided in terms of all existing methods of part identification (catalog number, stock number, supplier number, part name).

3.5.4 Content and style requirements for descriptive information. Descriptive information is non-procedural in form. It describes to the end-user background and supporting information which may be necessary for performing tasks. Descriptive Information may include theory of operation, physical arrangement diagrams, schematic diagrams and wiring diagrams. Descriptive Information shall be authored in accordance with the requirements of the specification. Required types of Descriptive Information shall be specified by the acquiring activity.

3.5.5 Content and style requirements for operational information. Operational information consists of procedural and descriptive information which is necessary for the operation of a system. Operational information shall be authored in accordance with the requirements of this specification. Specific types and requirements of operational shall be specified by the acquiring authority.

4 QUALITY ASSURANCE PROVISIONS

4.1 Quality assurance. To assure that the provisions of this specification are fully adhered to, the Contractor shall inspect the Procedural Technical Information in accordance with provisions of MIL-M-IETMQA: Quality Assurance (QA) Program Requirements for Technical Information (TI).

5 PACKAGING

5.1 Packaging, packing, and marking for shipment. This specification does not specify an end-item deliverable but is used by reference to a specification that does require a end item deliverable. Packaging requirements are presented in that specification.

6 NOTES

6.1 Intended Use. This specification is intended for use by the Government in the acquisition of an Interactive Electronic Technical Manual or view package, to provide general content, format, and style requirements in the generation of technical information required for operation, maintenance, and logistic support of military equipment.

6.2 Definitions.

6.2.1 Action statement. A sentence containing an action verb and an object or item upon which the action is to take place; e.g., remove the front panel.

6.2.2 Content. The subject matter presented in the Procedural discussions, Descriptive Information, or parts data; e.g., the actual Task descriptions, as opposed to headings, indexes, etc.

6.2.3 Descriptive information. Information or data including, but not limited to, principles of operation, system/component parts descriptions, source codes, and Schematic and Wiring data.

6.2.4 Equipment-Item Locator Illustration. Illustrations which show the relationships among equipment items and major-equipment modules.

6.2.5 Format. The general plan of organization or arrangement of information including order, shape, sequence, and general method of presentation of written data and illustrations.

6.2.6 Indication statement. A statement which presents the name of the indicator which the user observes and the indication. The indication is conventionally the normal or expected indication when the equipment is functioning properly.

6.2.7 Initial setup ((F) Input conditions). The information required by a technician before he can start the procedure - it tells him how to prepare the work area, what tools will be needed, how much time the job will take; and it provides him with other critical information. It also lists the major equipment items, personnel requirements, and specific skills which may be involved.

6.2.8 Major-equipment locator illustration. An illustration which shows the relationship of the major equipment to the overall equipment or system. May be given in several descending steps (e.g., system, subsystem, assembly board, etc.). At the most detailed level, it is an equipment-item locator illustration.

6.2.9 Nomenclature. The officially assigned name of a piece of equipment, part, tool, etc.

6.2.10 Procedural data. Step-by-step procedures including, but not limited to, checkout, calibration, operation, repair, alignment, weapons system test, troubleshooting, removal, replacement, installation, and associated check-lists

6.2.11 Style. Those aspects of presenting information consisting of the control of symbols on a medium, including the syntax, spelling, capitalization, size, font, punctuation, and typographic arrangement and display.

6.2.12 Subtask. A group of related actions (steps) which fulfills a limited purpose within a task. It is a complete start-to-finish, step-by-step action in a logical sequence of occurrence. It is composed of steps.

6.2.13 Subtask step. The basic unit of the procedure (made up, usually, of the smallest logically definable set of actions) which the user is required to perform in completing a subtask; e.g., a single action initiated by a specific signal on a specified display or other source of information; or providing a specific control actuation or other identifiable response.

6.2.14 Task. A group of related actions or combinations of actions required of a user within a given work cycle or routine, which is directed toward a specific work objective; and consists of the composite of the information, decisions, and responses required to accomplish a unit of work. A task is usually broken down into subtasks.

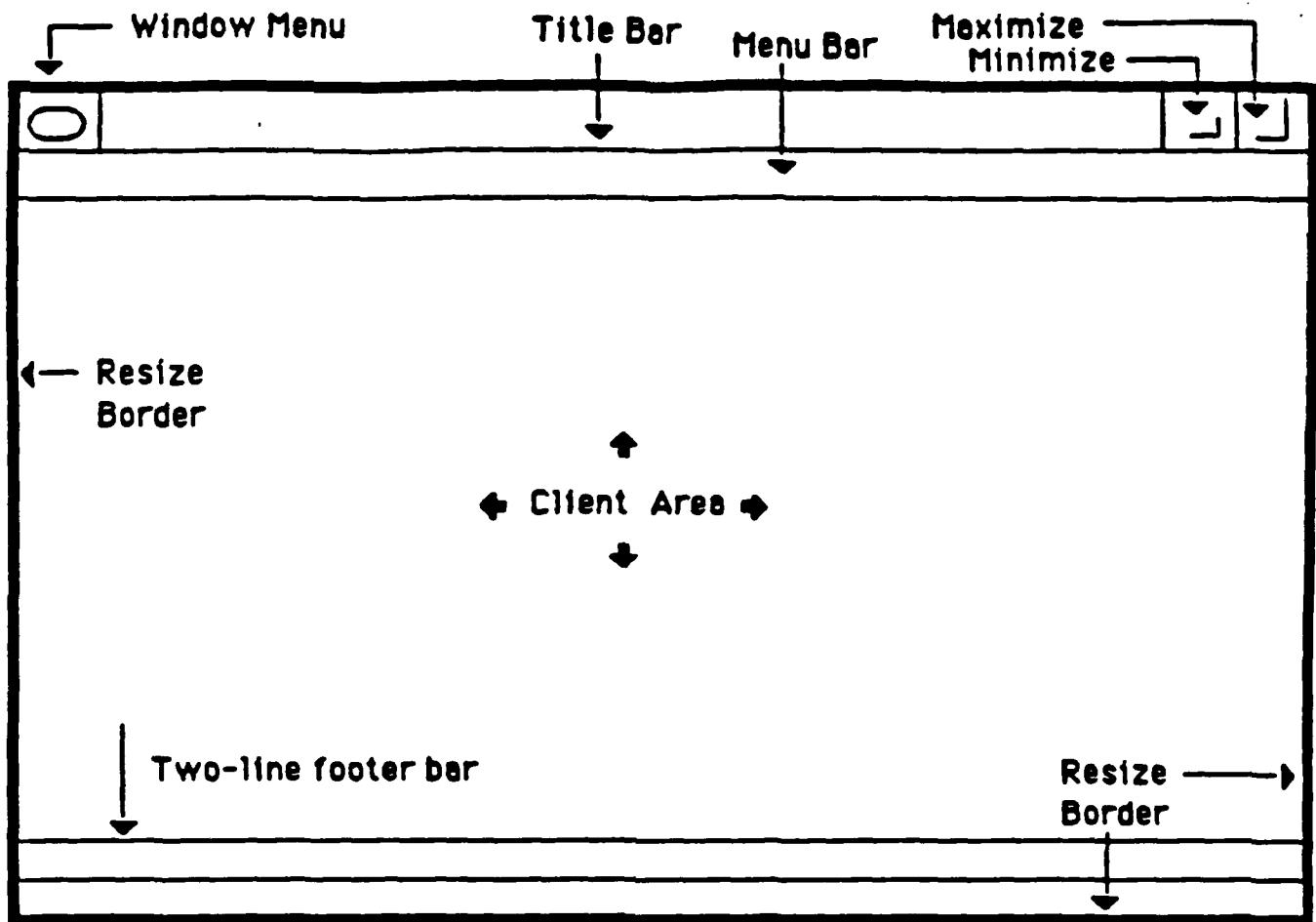


Figure 1.

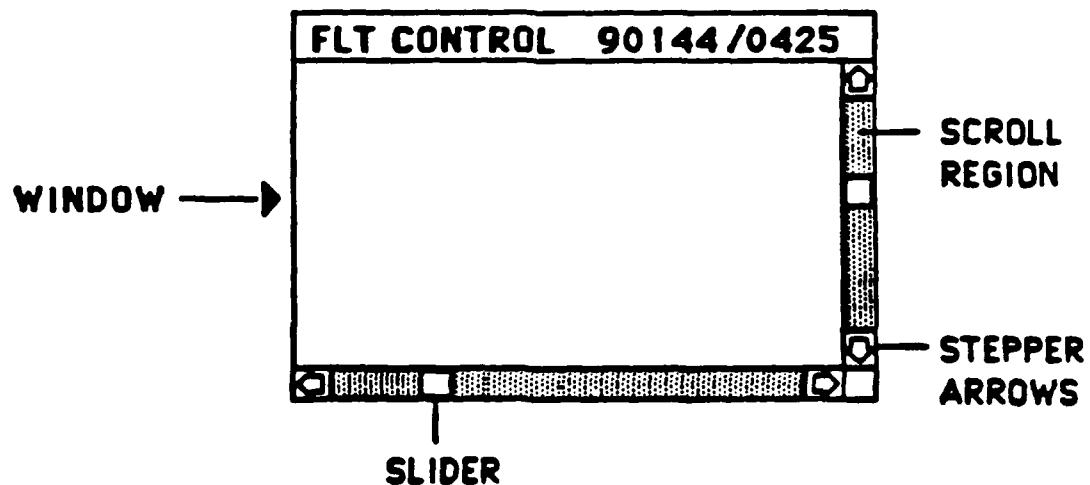


Figure 2.

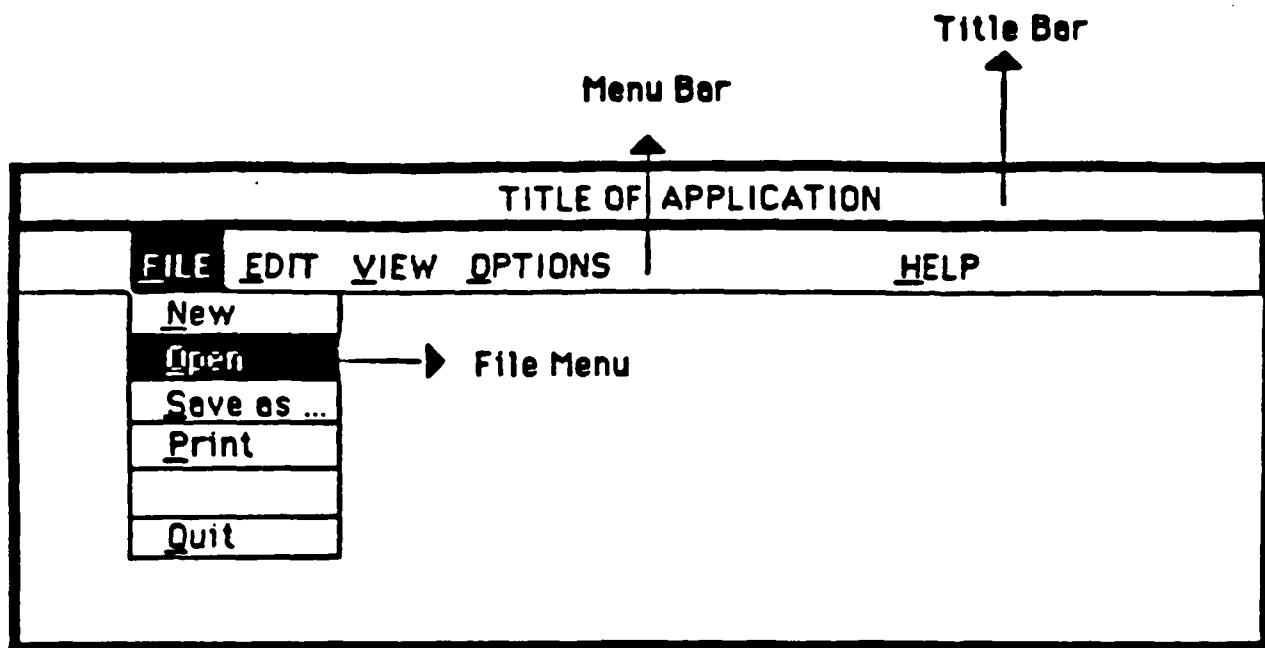


Figure 3.

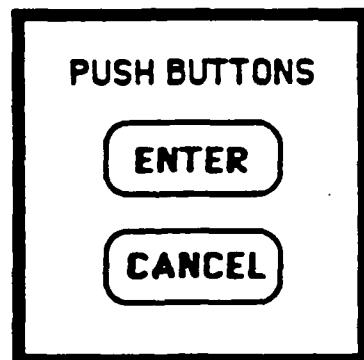


Figure 4.

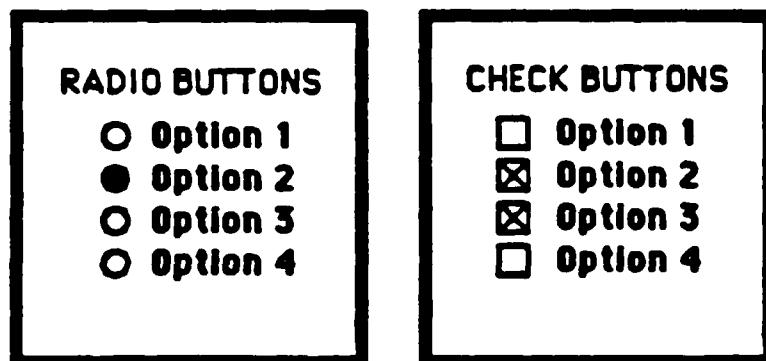


Figure 5.

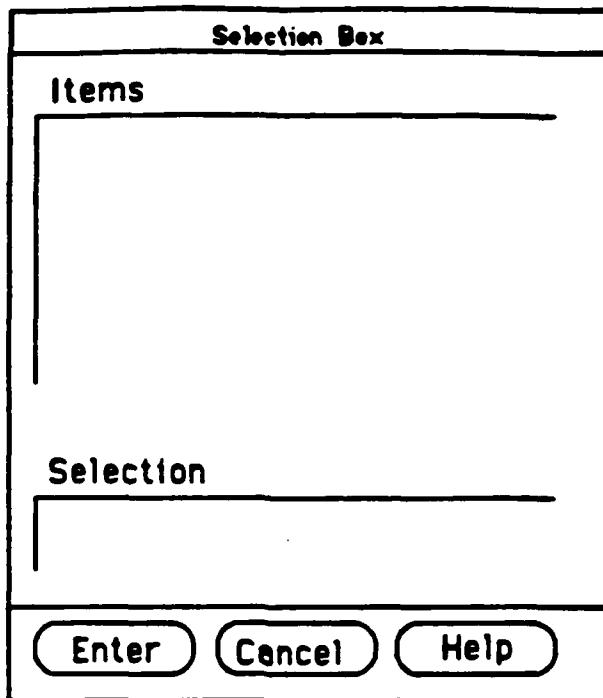


Figure 6.

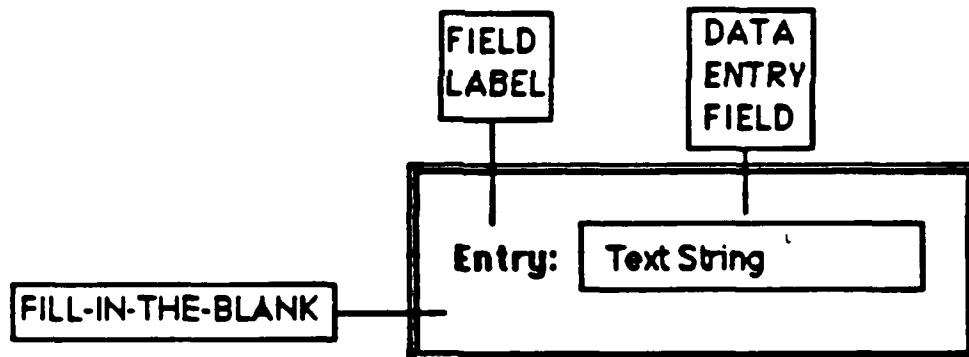


Figure 7.

Figure 8.

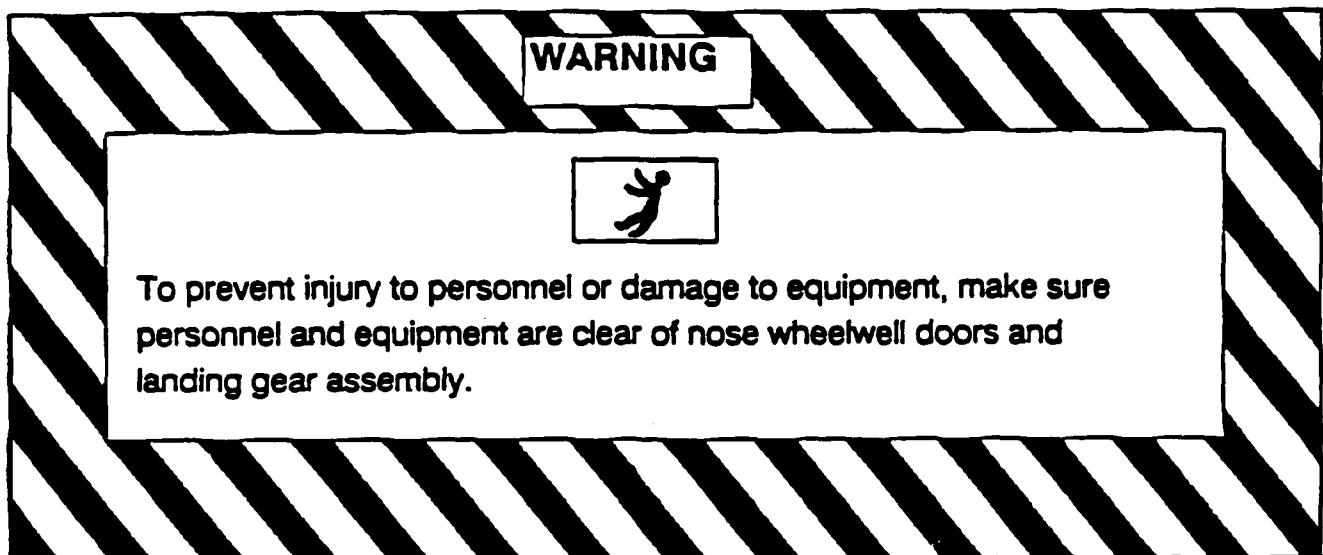


Figure 9. Precautionary Messages.

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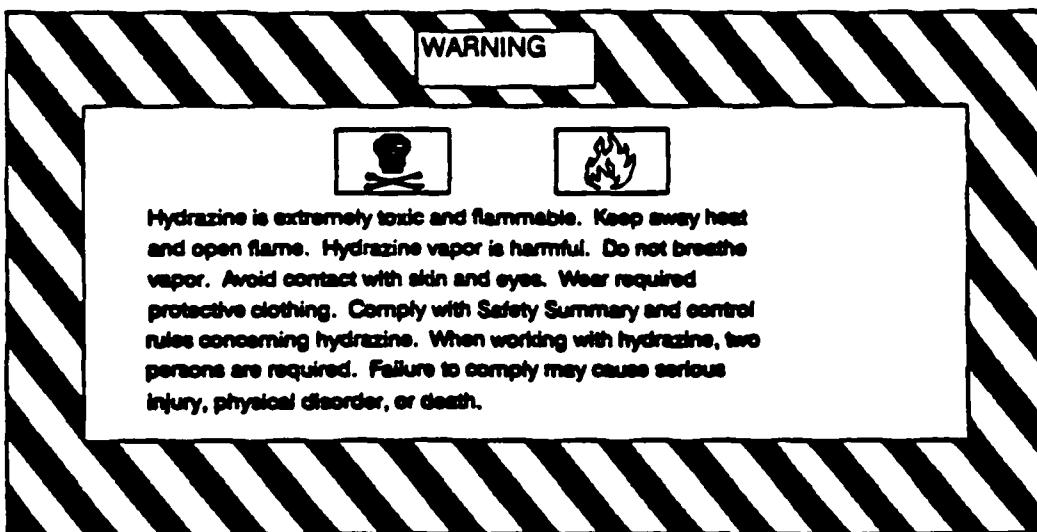


Figure 10. Related Precautionary Messages.

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